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NOTES ON THE AMERICAN SPARROW HAWK

BY A. I. ROEST

THE American Sparrow Hawk (*Falco sparverius*) occurs abundantly throughout the nation and has been well known to science for many years. In spite of this familiarity, knowledge of its natural history is rather sketchy. The accounts in the literature, with few exceptions, are primarily concerned with distribution records, nesting dates, and food habits, plus scattered descriptions of behavior (see Friedmann, 1950: 726-739). The present study was undertaken to investigate some of the less well known aspects of the life of the Sparrow Hawk.

Field observations were made at Corvallis, Oregon, from January 1951 to September 1952, and at Bend, Oregon, from September 1952 until December 1954. Notes made prior to 1951 in California, New York, and Virginia were also utilized. Fourteen captive birds kept for varying periods provided supplementary data.

Additional information came from a number of sources. The Banding Office of the U. S. Fish and Wildlife Service supplied data on Sparrow Hawk banding returns up to 1953. A postcard questionnaire requesting data on sex ratios and plumages was sent to 50 museums and zoos throughout the United States and Canada, and information on 1952 specimens was obtained. Dr. Alden H. Miller of the University of California and Dr. Robert W. Storer of the University of Michigan kindly supplied weight data for specimens in the collections at their respective institutions. Dr. K. L. Gordon of Oregon State College was especially helpful in preparing the manuscript, and the Braly Egg Collection at that institution was carefully analyzed. I would like to take this opportunity to thank the above individuals and institutions for their assistance in this project.

In order to avoid repetition, only new or relatively neglected material is presented here; only references pertinent to the present discussion are cited. For simplicity, material dealing with the an-

nual cycle of the Sparrow Hawk is presented first, in chronological order, beginning with the return of the birds to their nesting grounds in the spring. Following this are sections dealing with the more general topics of behavior and populations.

Pre-nesting Behavior.—In the vicinity of Bend, the first males arrive about the end of March (March 20–28), and the first females only a day or two later (earliest, March 29). By the first week in April the local breeding population has arrived, and nesting commences almost immediately. In other parts of the country, especially at lower elevations, nesting may be earlier, but there seems to be little correlation with latitude. The Braly Egg Collection includes a set of Sparrow Hawk eggs from Florida taken April 11, and a set from Canada dated April 12. Actual dates in any locality are probably dependent largely on local weather conditions.

An observation made in Bend, on April 20, 1954, indicates that the female may select her mate rather than the reverse. A wild female was seen twice that day in a tree near our backyard. A captive male was tethered there, and on each visit he became quite excited, yelling loudly, although the female remained quiet. The female stayed about five minutes each time. The captive male had yelled considerably on each of the preceding four days, possibly reacting to earlier visits of which I was not aware.

Dr. Donald Dunlap, of Washington State College, told me of a group of Sparrow Hawks he had seen in a dead tree near Pullman early in 1952. There were four hawks, three of them moving about almost continually in one part of the tree, while the fourth sat quietly in the opposite side of the tree. Such a group gathered early in the year may have been engaged in courtship activity. This report, together with those of Childs and Mossman (1952) and Fast and Barnes (1950), may indicate that some degree of polygamy or polyandry occurs in this species.

I observed copulation only once during this study, on April 25, 1953, near Bend. The observation involved a mated pair, with eggs already laid. Both birds were first seen in a snag near the nest site, hopping about among the bare branches. After a few minutes the female flew off, the male following; then both quickly returned. Again they hopped about, eventually coming to rest on the same branch about two feet apart. The female turned her back to the male and assumed a horizontal position, flipping her tail up and down a few times. The male flipped his tail also, and moved up until the two birds were side by side. Then he quickly mounted and copulation took place, with some gentle wing fluttering on the part of the male

to maintain his balance. Copulation lasted twenty or thirty seconds, after which the male hopped over to another branch. Both birds began to preen, but the male flew off after about two minutes, leaving the female still preening. The female apparently initiated copulation by flipping her tail while in the horizontal position. A similar observation is recorded by Bishop (1925).

Nesting and Incubation.—The typical nest site of the Sparrow Hawk has been adequately described in the literature (see Bent, 1938). Tables 1 and 2, summarizing data from the Braly Egg Collection and

TABLE 1
NEST SITES USED BY SPARROW HAWKS

	Natural Cavity	Flicker Hole	Wood- pecker Hole	Maggie Nest	Hole in Cliff	Building
Author's data						
Oregon	2	6				3
Virginia	1	1				
New York	1					
Braly Collection						
Oregon		1			1	
California	12	15	3	2		
Canada	1	13	3			
Other	2	2				
Totals	19	38	6	2	1	3

TABLE 2
HEIGHT OF NEST ABOVE THE GROUND

Height (Feet)	Author's Data			Braly Collection			Totals
	Ore.	Va.	N. Y.	Ore.	Calif.	Canada	
4 to 9				1		1	2
10 to 14	3			1	1	8	13
15 to 19	1		1		2	1	5
20 to 24	1	1		1	1	3	7
25 to 29	1				2	3	6
30 to 34	2				4		6
35 to 39					3		3
40 to 49					4	1	5
50 plus		1			2		3

my own notes on nest sites, provide additional information. In brief, the favorite nesting site is an old flicker hole or natural cavity 10 to 35 feet above the ground.

My own data, combined with material from the Braly Collection, show the following distribution of clutch size for 60 nests: 3 sets had 3 eggs, 13 had 4, 41 had 5, and 3 had 6. Williams and Matteson

(1948: 76) mention a set of 8 eggs in a nest near Ft. McKinney, Wyoming.

Sumner (1929) gives the weights of Sparrow Hawk eggs as 14 and 15 grams; my notes show weights of 11.5 (for a sterile egg) and 15 grams. The incubation period is 29 days according to Sherman (1913), but in the vicinity of Bend is 30 to 31 days.

During incubation, the male assists the female by bringing food or by taking over the night shift. Behavior of this type was observed at two nests near Bend. At one, about a half hour before sunset on May 1, 1953, the male arrived in the vicinity of the nest and began moving from tree to tree, occasionally swooping at passing birds. Finally the female looked out of the nest hole and uttered a soft 'kree-kree.' The male then flew to a nearby juniper, searched about among the branches, and flew back to the nest tree with the hindquarters of a field mouse. He began plucking fur from it and fed a little. Soon the female left the nest and flew up into the tree close to the male. The latter came down to her, whereupon the female moved over, took the mouse, and began to feed. The male remained near her for about ten minutes, while she fed, but then dropped down to the nest and entered. After five minutes he emerged again, but reentered almost immediately. The female continued feeding until almost dark, finally flying off to another tree. The male had not come out of the nest cavity by the time observations ceased, with complete darkness.

In this instance the male must have stored the mouse remains in the tree previously. Food storing was also noted frequently in captive birds. These observations support those of Tordoff (1955).

At the other nest the male was seen perched near the nest tree shortly before sunset on May 3, 1953. The female came out of the nest, flying off to return after about five minutes. She perched in the nest tree as the male came down to her and held the hind portion of a lizard out to her, which she accepted. He then flew to a higher branch, where he remained as she flew away again. She returned a few minutes later without the lizard, entering the nest again, and about twenty minutes later the male flew off. In this case the male did not take over at the nest for the night, but the feeding behavior took place as at the first nest.

Nestlings and Development.—Young Sparrow Hawks dry out within an hour after hatching and are then covered with sparse white down through which pinkish skin is visible. Parts without down show the same pink shade, the legs having a hint of yellow while the bill, claws, and cere are almost white. The down is sparser over the

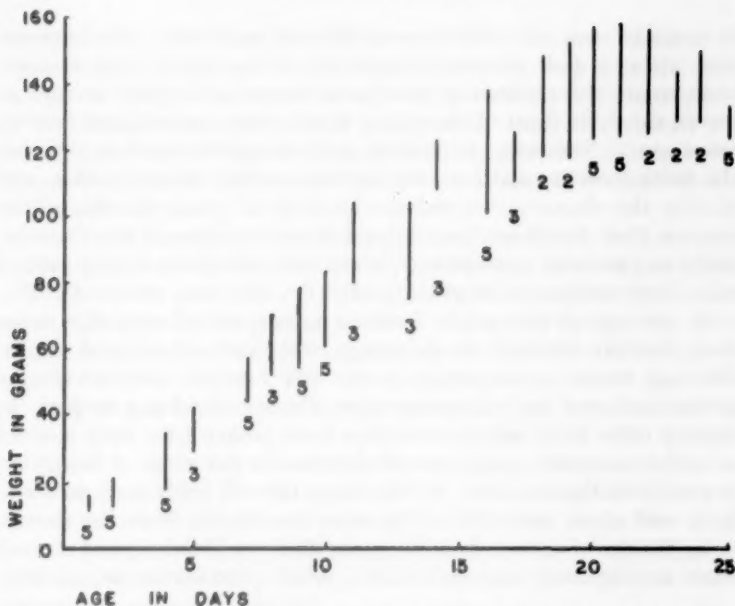


FIGURE 1. Weight increase in thirteen young Sparrow Hawks from three nests. The numbers below each bar indicate the size of the sample. In general, males weigh less than females after the fifth day. Variations are in part due to how recently the birds were fed before weighing.

abdominal and perineal regions, and the former protrudes as a "pot-belly." The wings resemble downy flippers. The egg tooth is prominent, projecting in some birds as much as 2 mm. Although the bill lacks a hook at the end, the typical falcon tooth is present.

Within two days the dark bluish-black eyes are partially open. The young hawks utter a faint buzzy cheeping when disturbed. The feet show a feeble grasping reflex. Although unable to sit erect, the birds can raise their heads shakily and open their beaks. Weights at this and later stages are presented in Figure 1.

At nests near Bend, the buzzy cheeping had been replaced by a chirp at the age of three days, and the immature 'killy-killy' mentioned by Sherman (1913) was noted. At the age of five days, one young male, removed from the nest, was able to sit up and turn about so as to face away from the sun.

By the end of the first week the skin under the down has begun to turn bluish on the wings, shoulders, back, and crown. The claws are beginning to darken, and the egg tooth is considerably smaller.

It seems to wear off rather than to drop off as a unit. The eyes are wide open, a dark chocolate-brown iris surrounding a deep cloudy-blue pupil; the nictitating membrane functions. When a card is waved slowly in front of the young hawks they are able to follow its movement. The wing quills have just started to develop. As yet the birds show no real fear, but become excited when handled, and display the characteristic defense attitude of young hawks, rolling over on their backs and presenting taloned feet toward the intruder. Belly and perineal area are completely bare, the down having rubbed off. Body temperatures average 101° F. (air temperature 68° F.).

At the age of two weeks feathers have sprouted over the entire body but are thickest on the wings, tail, back, chest, and crown. The egg tooth is completely gone. Sex can be fairly accurately determined now by comparing sizes, the females being larger. In slightly older birds sufficient feathers have broken from their sheaths to permit accurate sexing: grayish feathers on the wings of the males, brownish on the females. At this stage the tail quills are 2 to 3 cm. long, and about one-third of the vane has broken from the sheath.

By the age of sixteen days the young Sparrow Hawks spend most of their waking hours on their feet. When prodded or teased they

TABLE 3
WEIGHTS OF SPARROW HAWKS

Locality*	Number Males	Mean	Number Females	Mean
British Columbia (MVZ)	2	110.1 gm.	3	139.6 gm.
Washington (MVZ)			1	117.0
Idaho (MVZ) (UM)	4	106.8	2	109.6
Montana (MVZ)	2	96.6	3	130.0
Michigan (UM)	3	105.0	2	123.5
Oregon (MVZ) (OSC)	17	108.5	8	107.8
Wyoming (UM)			2	116.4
South Dakota (UM)	1	87.0		
California (MVZ)	32	102.7	32	116.5
Nevada (MVZ)	6	96.0	4	107.3
New Mexico (MVZ)	2	103.0	1	122.0
Texas (MVZ) (UM)	3	100.1	4	132.6
Lower California (MVZ)	10	100.5	7	117.3
Chihuahua, Mexico (MVZ)	6	92.2		
Florida (UM)			1	123.0
Yucatan, Mexico (UM)			2	129.8
	88		72	
Mean of all males— 102.5 gm. Extremes: 80.0–143.0 gm.				
Mean of all females—119.0 gm. Extremes: 86.0–164.8 gm.				

* Localities are listed from west to east, and from north to south. MVZ—Specimens from Museum of Vertebrate Zoology, Berkeley, Calif. UM—Specimens from University of Michigan Museum of Zoology, Ann Arbor, Mich. OSC—Specimens from Oregon State College, Corvallis, Ore.

revert to the squatting position, from which they can quickly roll over on their backs. When teased to this extent they may also utter a typical 'killy-killy' cry, although some individuals remain silent. When being fed, captives emit a cheeping sound, with bill closed, resembling the peeping of baby chicks. As Sherman (1913) noted, a marked difference in the behavior of males and females becomes noticeable now.

At twenty days the young falcons are well feathered, the remaining down being concentrated on the head and along the radius and ulna. The tail feathers are 6 to 6.5 cm. long. Much time is spent in preening and cleaning the developing feathers. They leave the nest about thirty or thirty-one days after hatching, at which time the wings are nearly fully developed. The tail is still decidedly shorter than that of an adult, and a few tendrils of down usually cling to the back of the head.

Figure 1 illustrates the change in weight as the young develop, showing the typical 'S' curve exhibited by most young birds. A peak is reached about the time the young leave the nest, when they weigh more than the adults. Table 3 presents the weight of 160 Sparrow Hawks, including both adults and immatures; no distinction was made when the data were collected.

Care of the Young.—During the earlier part of the nesting season, both parent birds are usually present at or near the nest, where the male is in most cases more aggressive in defending the nest against human intrusion than his mate. Whether nesting territories are actively defended against other Sparrow Hawks could not be determined. On May 20, 1953, while I was watching a female hunting near Bend, I saw a second female fly within 10 feet of the first, heading for a nearby nesting area. Neither paid the slightest attention to the other. Near Charlottesville, Virginia, on April 25, 1945, a pair of Sparrow Hawks loudly protesting having their nest investigated were joined by a third, a female, who entered into the proceedings more vigorously than the female of the pair.

After the young have hatched, the male is frequently absent from the nesting area, apparently in quest of food. When a nest is disturbed at this time the female will make an effort at defense, but in most cases her attack is not very effective. At one nest the female yelled once as she was flushed and then perched quietly nearby. The male soon appeared and began to attack, coming at times within arm's length of me in his gyrations. When the visit was over, the male disappeared quickly, and the female returned to the nest within 5 minutes.

The female's absences are few and of short duration. Apparently

the male hunts not only for the nestlings but for the female as well. Feeding of the young, however, is done almost exclusively by the female. Only once, at a nest near Corvallis, was a male observed to bring food directly to the young, entering the nest to do so.

After leaving the nest, the young stay with the adults for a short period. At this time a complete family group, adults and four or five immatures, may be seen cruising over a field together, or perched along a fence. Within a few days the young begin to drift away, and by the middle of July all young birds hatched in the spring are living independently.

Migration.—Near Bend, the summer population begins to drift south in September, the exact date depending largely on local food and weather conditions. They are gone by the middle of September, but during the middle of October migrants from farther north traverse the region. After October 25, no Sparrow Hawks are seen except for a few stray males which wander up from lower elevations during spells of warm weather.

The banding returns on Sparrow Hawks provide an idea of the general movements of the species. Although not nearly enough returns (only 210) are available to determine the migratory movements of this species as accurately as has been done for some other birds, certain trends are evident. Birds from New England and the central Atlantic coast move southward to winter in the Carolinas and Georgia, while birds from Kentucky, Ohio, Michigan, Minnesota, Saskatchewan, and Alberta concentrate in Texas, Arkansas, and Louisiana. No records from farther west are available except for two birds, banded in Arizona, that were subsequently reported from Sonora, Mexico.

Sparrow Hawks from northern areas appear to migrate farther to the south than those in more temperate areas. Birds from Pennsylvania and Maryland are most often recovered in North Carolina, whereas New England birds are picked up in South Carolina. A bird from Nova Scotia turned up in Florida, and two from near Edmonton, Alberta, were recovered in southern Texas, distances of over 1600 miles in each case. The record is held by a Sparrow Hawk banded at Peers, Alberta, and later killed near Kauki, Campeche, Mexico—an airline distance of over 2600 miles.

There is some indication that juveniles may move northward during late summer after leaving the nest. The following records of birds banded in June or July and recovered before October indicate this movement: Massachusetts to Maine; Ohio to Michigan; Oregon to Washington.

In some parts of the range, Sparrow Hawks may remain to spend the winter. In addition, birds from farther north may come down to winter with residents which have not migrated; this results in a population which is almost as large as that in summer. Western Oregon has such a wintering population, the birds congregating in the open country of the Willamette Valley (Tables 4 and 5).

TABLE 4
ROAD CENSUS FIGURES FOR SPARROW HAWKS IN OREGON AT DIFFERENT SEASONS

Date	Route	Miles	Birds Seen
February 23, 1952	Corvallis—Oceanlake	75	7
April 10, 1952	Corvallis—Eugene	40	1
April 10, 1952	Eugene—Cottage Grove	22	1
December 22, 1951	Corvallis—Eugene	40	11
December 28, 1951	Corvallis—Eugene	40	14

TABLE 5
WINTERING SPARROW HAWKS IN OREGON
(TAKEN FROM THE NATIONAL AUDUBON SOCIETY'S FIELD NOTES MAGAZINE:
CHRISTMAS CENSUSES FOR THE YEARS INDICATED)

	1939	1942	1943	1944	1945	1946	1952	1954
Western Oregon:								
Tillamook		1						
Portland	28	20	18	14	24	13		15
Eugene		9		21	6	29		31
Eastern Oregon:								
Medford								1
Warm Springs								3
Bend								0
Malheur Refuge	0		2	2				
Klamath Falls				3			0	

In eastern Oregon a few areas support small numbers of wintering birds, among them the grain country around Madras, the Malheur Refuge, and the Klamath Falls region. During periods of warmer weather these birds may wander widely. At Bend such individuals, all males, have been noted November 16, December 13, January 29, February 15, and March 3 in 1952 and 1953.

Molting and Plumages.—The annual molt takes place from July to October and may extend into November. In two juvenile captives at Corvallis, in 1952, the molt during their first fall commenced August 3, when one cinnamon feather appeared on the chest of the male. By August 6 the female showed ruffled, partially featherless areas about a centimeter wide on each shoulder, the result of losing 3 or 4 feathers from each spot. The male had two adult cinnamon-colored chest feathers by August 17. Both birds began to molt heavily

about the first of September, and by September 10 looked rather patchy. The male had the entire chest area outlined in cinnamon at this time, and by the 15th this region was completely refeathered in the adult shade. Up to this date, most of the feathers dropped were small contour feathers, but on the 17th larger feathers, from the back and wing coverts, were lost. By October 5 the molt was nearly complete, but a few feathers continued to drop until October 19. No flight feathers were lost at this time. (See also Parkes, 1955.)

During their second fall, Sparrow Hawks undergo a complete molt of both body and flight feathers. In a captive male this molt began July 3, when 2 primaries and 3 secondaries, plus some body feathers, were shed. One or two flight feathers were dropped every 2 or 3 days until July 15, when the rate slowed to one every week or 10 days. The first primaries lost came from the proximal portion of the wing, the molt working out distally. Bastard quills were dropped July 4 and 10, and the first tail feather (the first feather to the left of center) on July 14. Between August 22 and October 11 no wing feathers were shed, but on the latter date two secondaries were dropped and on November 5 two more, at which time the molt was over. During this molt the body feathers were also shed, but the new plumage differed little from the old except for a reduction in the number of spots on the chest.

The third annual molt in this particular bird began June 27, 1954, with two primaries. In the following weeks body, wing, and tail feathers were all molted. On September 3, only two of the old tail feathers remained, the new ones were half grown, and the bird had achieved a nearly immaculate cinnamon chest, with only a very few black spots around the edges.

Although there is a great amount of individual variation, especially in males, actual abnormal plumages appear to be rare. The questionnaires sent to museums and zoos turned up only two out of 1952 specimens. At the Chicago Museum of Natural History is a partially albinistic male, having the crown, back of neck, and wings smudged with black, the back tinged with reddish, and the tail patterned, although much paler than is usual. It was collected February 15, 1928, at Roswell, Georgia, by L. M. Taylor. A completely albinistic male is mounted and on display at the Museum of Natural History at the University of Oregon, Eugene, Oregon. Mr. George Brock collected it at Scio, Oregon, on November 8, 1900, and it was subsequently prepared by Dr. A. G. Prill of Scio.

Hunting and Feeding.—Sparrow Hawks spend much time perched quietly on an observation point during the middle of the day. Hunting

is done primarily in the morning and late afternoon. Characteristically the hunt occurs over open fields, the entire area being covered methodically by a combination of flying, hovering, and soaring. Flying appears effortless, with a quick wingbeat, and the hawk can easily maintain a speed of 20 miles per hour. (Checked at Corvallis, January 16, 1951, by car.)

If something attracts the hawk's interest, it hovers over the spot. In hovering, the tail is usually spread fully, while the distal portions of the wings are winnowed rapidly through an arc of 4 to 6 inches (equal distances above and below). The head is nearly always pointed into the wind, and the tail is lower than the body. In this fashion the Sparrow Hawk may hang over a spot on the ground, head turned down to watch anything worth closer attention, for periods up to a full minute, rarely longer. Then with a flip of its wings it will glide or fly over to a new location and repeat the performance. This stage of the hunting usually takes place at from 50 to 75 feet above the ground, but may be much higher. If prey is detected from this height, the Sparrow Hawk partially folds its wings and drops headfirst to a lower elevation to hover again. After a moment another drop is made to an even lower level, and the final distance to the ground is made with a pouncing swoop during which the feet are brought forward to grab the prey.

In hunting insects the same general pattern is followed, except that the final swoop is replaced by a slow, feet-first descent, with wings fluttering above the hawk's back, and ends with a quick drop.

A third type of hunting frequently observed is conducted from a vantage point, such as a telephone line. The hawk keeps the immediate vicinity under close observation and if suitable prey presents itself, flies directly to the spot and makes the capture. This hunting style, although often used for mammals and reptiles, seems to be more effective for insects. Frequently tadpoles or water beetles in a roadside ditch may be located in this manner.

In soaring, the hawk spreads its wings to their fullest extent, so that they appear less pointed than usual. The tail is also spread, but not to the same degree as in hovering. Circles and figure-eights are the most frequent patterns followed, and control is accomplished by adjusting the spread of the tail, or by twisting it.

The capture of prey is made by the feet in most cases, and if large it is killed by a quick bite at the base of the skull. Insects are rendered helpless by the grip of the feet, or by biting. After capture, the prey is taken to a suitable perch, anything from a bush 2 feet high to a building of several stories. The head is almost always attacked

first, perhaps because the skin elsewhere does not offer a good purchase. Captives, for example, hold a mouse or young rat in the lumbar region with one or two claws on each foot, then bite the head, crushing the skull. No tearing is attempted until the beak encounters a good grip on an eyelid, ear, or lip, after which the skin is quickly torn off in small strips to expose the underlying flesh. The strips may be either discarded with a toss of the head or swallowed. Small insects are swallowed whole, but large ones are held by the abdomen in one foot while successive bites work down from the head, very much as a small boy eats a hot dog.

Only once was a captive seen to drink. This bird, taken on a three-day trip through northwestern California, Nevada, and the Mojave Desert, in August, 1953, took several beakfuls of water at the end of the trip. Wild birds were never seen to drink.

Behavior of Captives.—The behavior of young birds during their development has been outlined above, but one exception noted only in captives should be mentioned. At least 5 captives displayed an attitude which may best be termed "setting." It occurred at the age of 5 or 6 weeks, and consisted of lying flat, the wings sagging limply on the ground. The feet were either tucked up under the body or extended posteriorly, while the head was usually erect, although hunched down on the shoulders. In this position the young hawks would often lie in the morning sun, picking ants off the grass in front of them. Later in the day they would "set" on their perches, so relaxed that wings and tail drooped down.

This "setting" attitude may be associated with the fact that the young birds' muscles and bones have not yet become accustomed to sitting for long hours on a hard perch, as they do in captivity. In the wild, the strain on feet and legs is relieved by periods of flying.

On hot days most birds relish a shower from a garden hose with nozzle adjusted to a fine spray. When hosed down in this manner they crouch and ruffle their feathers, dipping and bobbing their heads as though bathing in a pool. Such bathing activity was once noted in a hawk perched four feet above the ground in its cage, during a mild summer rain.

Differences in behavior between the sexes have been mentioned earlier; some examples may clarify this situation. A young male and female taken from a nest near Corvallis were typical. The male quickly adjusted to the routine of being approached, handled, weighed, and fed, and after 3 or 4 days submitted to such treatment with little protest. The female continued to yell, rear back, and attempt to escape for nearly 10 days.

Even when the birds had been in captivity for a year or more, this difference was quite noticeable. The male would permit a close approach when the cage was entered, but the female became extremely excited at such times. These examples are not isolated ones. Of the fourteen Sparrow Hawks kept captive during this study, the 6 males were all much the easier to handle, although treated identically as the females. Various observers have noted similar differences in behavior (Holland, 1923; May, 1927; Sherman, 1913). In wild birds the difference is not noticeable except in connection with defense of the nest.

It appears to me that the male Sparrow Hawk may have the greater ability to adjust to changed conditions. This ability may have evolutionary significance when new range extensions are being established and may partially explain the preponderance of males in the population (see Sex Ratios below).

Sparrow Hawks also show considerable variation in individual behavior. One captive male quickly became so tame that I could walk right up, hold out my finger, and have him step up on it to 'chrrr' gently. Even when not hungry, he would fly to my shoulder to be carried about when I entered the cage to clean it. He remained extremely shy of strangers, however, in contrast to another bird. This second hawk, also male, could be approached and handled by anyone and even ignored dogs which came up to sniff. He was by no means the pet that the first male was, however. A female captive showed the opposite extreme, becoming very excited, yelling and flying about in the cage even at such routine disturbances as feeding. Even after 15 months she seemed no tamer than the day she was taken from the nest.

A juvenile male was given to me in 1953, showing hunger streaks—signs of poor feeding when the flight feathers were developing. In preening during the first fall molt this bird encountered these weak spots and chewed at them. In two months all flight feathers in wings and tail had been removed, leaving only half-inch stubs. Later a minor injury to one toe started him biting at his feet. Although the original injury had been just a scratch, continued pecking enlarged it, causing the talon to be lost and the bone exposed. Because of the constant pecking the wound could not heal. On March 25, 1954, a large blood vessel was exposed, and bleeding was continuous thereafter. On the morning of March 28, following a night of 18° F. temperature, this bird was found dead. Apparently loss of blood and cold were responsible.

Interspecific Relations and Mortality.—The Sparrow Hawk is sub-

jected to a certain amount of harassing by other birds. Brewer's Blackbirds frequently chase them when in flight, but do not seem to be so bold when the hawk is perched. In flight the blackbirds follow closely, and on occasion may peck the hawk on the back. On June 7, 1953, near Bend, a male Sparrow Hawk was observed feeding unconcernedly as blackbirds hopped all about, not more than a foot away. They made no attack until the hawk finished eating and flew off, upon which 8 or 10 followed closely, heckling all the way. Robins and Clark Nutcrackers were also seen to chase Sparrow Hawks. Male Robins may spend hours yelling at young captives, diving within a few inches of them. Other birds, such as House Finches, House Sparrows, goldfinches, and swallows, protest the presence of the young hawks by chirping or flying about but leave after 10 or 15 minutes.

The Sparrow Hawk is not always the receiver in interspecific encounters. During this study they have been seen to chase and harry Robins, Band-tailed Pigeons, and Red-tailed Hawks, the latter usually when they are carrying prey. On January 21, 1955, Mr. Robert Jewell and I watched a male Sparrow Hawk making repeated dives at a perched Goshawk. At each pass the Goshawk crouched and fluttered its wings. After about 25 such passes (in about 1 minute) the Goshawk flew off, closely pursued by the Sparrow Hawk.

Sparrow Hawks have relatively few known natural enemies, some of the larger birds of prey being most important in this respect (Cade, 1951; Carnie, 1954; Fitch, 1947). Fish and Wildlife Service banding records mention two Sparrow Hawks killed by other hawks, one of which is identified as a Red-tailed Hawk. Dr. Robert W. Storer informs me that Sparrow Hawk remains have been found in the stomachs of a female Sharp-shinned Hawk and a male Cooper's Hawk (data from the U. S. Fish and Wildlife Service stomach analysis records). In Corvallis a Cooper's Hawk made an unsuccessful attack on two captives tethered in the backyard.

Man is probably the most serious enemy of the Sparrow Hawk. Banding returns show that of 185 birds for which the cause of death was listed, 45 were shot. Two other categories, "found dead" (52) and "killed" (33) probably include a number of birds which were shot. Other causes of death, most of which may be attributed to man, include "trapped" (28), "captured" (12), and "died" (15).

Some unusual cases should be mentioned. The banding records include one bird which was "attacked by kingbirds, protecting their nests, driven to the ground and killed by two other Sparrow Hawks." One each was "killed by jays," "by a cat," "by lightning," "flying

into a window," "hit by car," and "hit by locomotive." One died of starvation, another "from cold," and a third from parasites.

Only a few species of parasites have been reported from the Sparrow Hawk. During the present study only two were observed. A single louse, determined to be *Degeeriella giebeli* Hopk. by Dr. C. F. Muesebeck of the U. S. National Museum, was obtained from an adult female. In the spring of 1953, black flies were found in great numbers at one nest near Bend, biting the young hawks through their down and causing local irritation. Dr. A. Stone (USNM) identified specimens collected at this nest as *Simulium canonicolum* (D. & S.). The five young and the adult female at this nest showed excessive yellow pigmentation of the legs, cere, and circumocular skin, these areas appearing almost orange. In addition, the legs were so swollen that an aluminum band of the proper size could not be fitted so as to allow room for it to turn on the leg. Subsequently two of the young at this nest disappeared; the remaining three were females.

This pigmented condition was mentioned to Dr. Patricia O'Connor, veterinarian at the Staten Island Zoological Park, New York, who replied that a similar condition had appeared in several birds at the zoo, including a King Vulture. Upon its death autopsy showed a distinct nephritis, but whether this had any connection with the swelling of the legs could not be determined.

The band of one of the two young hawks which disappeared at the above nest was found in debris at the bottom of the nest in 1954. It was filled with a mass of fibrous material similar to that found in a hawk casting, and hence it seems likely that this young hawk, the runt at the time of its disappearance, had been eaten by its nest-mates.

Very little information is available concerning the life span of wild birds, banding records being the only source of data. Up to 1949 2661 Sparrow Hawks had been banded, an average of only 92 a year since 1920. Only 210 bands were recovered between 1924 and 1953—approximately 7 each year. Considering the abundance of Sparrow Hawks, this represents a very small sample and the following results, based on analysis of this sample, may be far afield.

The reports provide data on 150 birds of known age (adult or juvenile) at the time of banding (Table 6). On the basis of an average annual mortality of 57 per cent, the life expectancy of banded Sparrow Hawks is about 1 year and 3 months. Bond (1943) mentions that 75 per cent of all mortality occurs between August and November, amounting to from two-thirds to one-third of the entire population. The oldest bird reported was a female, recovered 5 years and 11 months after being banded as a juvenile.

TABLE 6
MORTALITY OF BANDED SPARROW HAWKS

	Years after banding					
	1	2	3	4	5	6
<i>Adults:</i>						
Number of banded hawks alive at beginning of year:	45	18	9	4		
Number of banded hawks which died during the year:	27	9	5	4		
Mortality (per cent)	60	50	55			
<i>Juveniles:</i>						
Number of banded hawks alive at beginning of year:	105	39	12	7	3	1
Number of banded hawks which died during the year:	66	27	5	4	2	1
Mortality (per cent)	63	70	43	57	60	
Average annual mortality: 57 per cent.						

TABLE 7
AGE OF CAPTIVE SPARROW HAWKS

Institution	Age
Chicago Zool. Park, Brookfield, Ill.	3 yr. 5 mo.
Lincoln Park Zoo, Chicago, Ill.	4 yr.
City Zoo, Buffalo, N. Y.	4 yr.
Washington Park Zoo, Portland, Ore.	4 yr. 7 mo.
Philadelphia Zool. Park, Phila., Penn.	6 yr.
Philadelphia Zool. Park, Phila., Penn.	6 yr.
Philadelphia Zool. Park, Phila., Penn.	6 yr.
City Zoo, Memphis, Tennessee	7 yr.
National Zool. Park, Washington, D. C.	9 yr.
City Zoo, Calgary, Alberta, Canada	2 yr.

Data from questionnaires—for list see Table 8.

In captivity Sparrow Hawks show an average life span of 5 years and 2 months (Table 7). An exceptional case (not listed in the table) was that of a male kept as a house pet for 14 years before strangling on a curtain cord (letter from Mr. Jack Marks, Director of the Washington Park Zoo, Portland, Oregon, dated February 5, 1953).

Sex Ratios.—Information from a number of sources indicates that there are more males than females in the Sparrow Hawk population. On longer trips taken during this study, the sexes of Sparrow Hawks seen were recorded whenever they could be determined. To insure inclusion of females which might be at the nest, only late summer, fall, and winter records were included in this tabulation. These records totalled 107 birds, of which 67, or 63 per cent, were males.

TABLE 8
SPARROW HAWK SEX RATIOS

<i>Museums</i>		<i>Males</i>	<i>Females</i>
Arizona	Univ. of Arizona, Tucson	4	5
California	Cal. Acad. Sci., San Francisco	78	54
	Los Angeles Museum, Los Angeles	27	24
	Mus. Vert. Zoology, Berkeley	178	194
	San Diego MNH, San Diego	48	50
	Santa Barbara MNH, Santa Barbara	12	7
Colorado	Denver MNH, Denver	36	19
	Univ. of Colorado, Boulder	10	4
Idaho	Univ. of Idaho, Moscow	7	3
Illinois	Chicago MNH, Chicago	133	121
Iowa	Iowa State College, Ames	1	1
	Univ. of Iowa, Iowa City	30	7
Kansas	Univ. of Kansas, Lawrence	38	29
Michigan	Mich. St. College, East Lansing	5	1
	Univ. of Michigan, Ann Arbor	107	135
New Mexico	Univ. of New Mexico, Albuquerque	2	1
New York	American MNH, New York City	116	118
	Cornell University, Ithaca	41	24
Ohio	Cleveland MNH, Cleveland	36	21
Oregon	Ore. St. College, Corvallis	18	15
	Univ. of Oregon, Eugene	6	2
Pennsylvania	Penn. St. Coll., State College	11	4
Washington	Wash. St. College, Pullman	8	8
	Univ. of Washington, Seattle	20	12
Wisconsin	Univ. of Wisconsin, Madison	6	3
Totals:		978	862
<i>Zoological Parks</i>			
Colorado	Denver Zoo, Denver	'scores'	
Illinois	Brookfield Zoo, Brookfield	11	6
	Lincoln Park Zoo, Chicago	1	3
Kansas	Wichita Zoo, Wichita	0	0
New York	Bronx Zoo, New York City	'many'	
	Buffalo Zoo, Buffalo	1	0
Oregon	Staten Island Zoo, Staten Island	'many'	
	Washington Park Zoo, Portland	1	0
Pennsylvania	Philadelphia Zoo, Philadelphia	35	43
Tennessee	Memphis Zoo, Memphis	3	7
Canada	Calgary Zoo, Calgary, Alberta	1	0
	Winnipeg Zoo, Winnipeg, Manitoba	0	0
Totals:		53	59

Total males: 1031, or 52.8 per cent. Total females: 921, or 47.2 per cent.

Only institutions which answered the questionnaire are listed. Where a college or university is named, the questionnaire was sent to the Museum of Natural History (MNH) at that college.

Males amounted to 53 per cent of the 1952 specimens reported in the questionnaires which were sent out (Table 8). The weights of 160 Sparrow Hawks were obtained, males representing 56 per cent of that sample. Exactly 65 per cent of all returns on banded birds are males. And finally, at Hawk Mountain Sanctuary in Penn-

sylvania, Broun (1949: 171) reports that 65 per cent of the migrating Sparrow Hawks observed are males.

In contrast to these figures, notes from nine Oregon nests where the sexes of the nestlings were recorded show only 12 out of 34 (35 per cent) were males.

SUMMARY

Among Sparrow Hawks there is evidence that polygamy or polyandry may occur, and that the female selects her mate and initiates copulation. The female is assisted in incubation by the male, who also brings food to her and the nestlings, and is more active in defense of the nest. Food may be stored for future use.

The young at various ages are characterized by feather development and voice. They leave the nest about a month after hatching. Weights of both young and adults are presented. Banding returns indicate the young may drift northward in late summer. Migration begins in September, the most northerly nesting birds travelling farthest south. In favorable northern areas Sparrow Hawks may remain through the winter.

The annual molt starts in July and ends in late October. The first year this is a body molt only, but a complete molt occurs in the second year. The same appears true for the third annual molt. Two albinistic birds were reported from among 1952 specimens.

There is considerable individual variation in behavior, and a definite difference in behavior between the sexes, most noticeable in captives. The males seem to be more adaptable to new situations.

Banding records indicate an average annual mortality of 57 per cent, pointing to a life span of about one and one fourth years. Captives may reach an age of 14 years. Evidence indicates that about 60 per cent of the population are males.

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IN MEMORIAM: ADRIAAN JOSEPH VAN ROSSEM

BY ALDEN H. MILLER

ADRIAAN VAN ROSSEM was a colorful, dynamic and highly competent ornithologist of international reputation who was lost while at the crest of his accomplishments at the age of 56. I knew him well from daily companionship in the field and from long professional contact. In the six years since his death, while thinking back over the events of his life, I have become convinced that his distaste for any show of sentimentalism and his inclination for blunt and incisive appraisal of self and others reflected a desire that his career be recorded with candor. "Van" was a man of startling and often puzzling contrasts. Personal charm and consideration shown toward some people were balanced against thoughtlessness and bitterness toward others. Generous acclaim and support of colleagues was often warmly expressed by him while competitive feuds grew apace in other quarters. And one can note that skillful cultivation of some lines of support and backing seemed not in keeping with his self-declared lack of diplomacy. Accurate, sensitive, and significant scientific work alternated with hasty, emotionally promulgated offerings. Nothing was ever gray or indecisive; matters were always black or white, or red. The most constant feature of his make up, and one to be deeply admired by every ornithologist, was a complete and never-lagging interest in birds. Nothing else really mattered; all other things could ruthlessly be put aside. The buoyancy of his enthusiasm in the field and the museum seemed undiminished in his last years from that of the youthful twelve-year-old collector operating in the Arroyo Seco near Pasadena.

Adriaan Joseph van Rossem was born in Chicago, Illinois, on December 17, 1892, the son of Adriaan Cornelis van Rossem and Josephine Williams van Rossem. His father was a member of a family well known in municipal and business circles in Rotterdam, Holland, and in the Dutch East Indies. Following residence in London he had come to Chicago as a convenient point for international business exchange. A. C. van Rossem had had European collegiate training and possessed excellent linguistic ability. On November 11, 1891, he married Joséphine Williams. Her father, Joseph Williams of Goderich, Ontario, was engaged in timber, manufacturing, and shipping business in the Great Lakes area and was widely known for his interest in educational institutions. In August of 1894, A. C. van Rossem's health occasioned alarm and visits to Holland and Switzerland followed, for medical care and rest. He died on



ADRIAAN JOSEPH VAN ROSSEM



February 6, 1895, at Leysin sur Aigle in Switzerland and the widow and her two small boys, ages 1 and $2\frac{1}{2}$, returned to Canada. In September, 1895, Mrs. van Rossem took up residence in California and built a house overlooking the Arroyo Seco in Pasadena. Here the children were raised by her, and young Adriaan attended public and private schools, entering Throop Institute (then a preparatory and high school, later to become California Institute of Technology) in 1903 where he was encouraged and counseled in his interest as a naturalist by Joseph Grinnell. Following Grinnell's move to Berkeley, California, in 1908, van Rossem and he corresponded regularly, and an exchange of letters in January of 1914 reflected the guidance Grinnell gave and its cordial reception. On January 9 Grinnell wrote in part: "I am frank to state that I consider your article excellently written [van Rossem's fifth published article, on the Derby Flycatchers he observed in El Salvador in 1912]. It shows at the same time a high grade of observational ability. If you can turn out work of this good quality with relatively little preliminary experience, I would say that you would make a mistake in not following up this line of work and thus put your talents to good use." Grinnell was aware of Van's various youthful escapades and was here making a sincere bid to encourage a life-time focus of interest which was already strongly indicated. Van responded on January 14: "Your criticism of my paper and the remarks concerning my future were decidedly encouraging to me. I will keep the corrected article to use as a key to the composition of the next one, as that which I just sent in got me 'het up' considerably."

Van's earliest field work outside the Pasadena area included collecting trips to the Coronados Islands in April of 1909 (age 16) with James B. Dixon, to the Salton Sea region in the winter of 1910-11, and to Santa Cruz Island in the spring of 1911 with A. Brazier Howell. There grew from this last association a plan to collect in El Salvador, Central America, especially to procure species on "the North American list." Later (1938) in writing of this sojourn in the tropics which extended from February 10 to August 20, 1912, he said: "I . . . made a small collection of birds, the gathering of which must be confessed was conducted with a large amount of youthful enthusiasm combined with a minimum of judgment." On February 16 he wrote Grinnell that he arrived in San Salvador "after a considerable tussle with the customs people. . . . Everything is OK now and I am armed with several dozen permits. . . . Of course I am at sea at present, all the birds with exception of a few migrants being absolutely new to me." Thus he was launched on a life-time work on the fascinating

study of tropical birds in a fashion and under circumstances not dissimilar to the introductions still experienced with relish by many ornithologists on their first trip to Latin America.

In early 1913 a "near-to-nature idea" of the family led to the purchase of a ten-acre ranch in Pomona. Van did not like the ranch work and a year later in February reported "we have sold this — walnut ranch at a substantial profit and for my part never want another. I would rather collect a year than ride a cultivator a week." Van was already firmly established as a skilled and vigorous preparator and field man. Accordingly for the year 1914–1915 (October 15 to June 5) he was commissioned by J. Eugene Law to collect for him in the Chiricahua Mountains of Arizona. An extraordinarily fine collection was assembled which for many years was on deposit at the Museum of Vertebrate Zoology but which recently has been removed to Virginia by its owner, Mrs. Laura Law Bailey. No publications resulted from this work as van Rossem and Law fell into strong disagreement concerning the conduct of it and appropriate compensation. This conflict of two determined personalities unfortunately persisted in various manifestations and colored many of Van's later relations with ornithologists in southern California.

From 1915 to 1917 Van worked in mining and real estate enterprises which took him for some time to Sierra City in the Sierra Nevada. His true interests are reflected in his statement of October 5, 1916, to Grinnell "that there was very little time to collect anything the past summer but by hunting before breakfast and skinning after supper I managed to prepare about three hundred." He also worked in 1917 for the B. F. Goodrich Company with Chester C. Lamb in their touring bureau as road markers and inspectors.

In April of 1917 Adriaan and his brother Walter Johannes (Jack) enlisted in the United States Army, and following training at San Diego and at Fort Lewis, Washington, Adriaan entered officers candidate school in November and worked out his war service in Georgia. He was commissioned a Second Lieutenant on June 5, 1918, and First Lieutenant on November 19, serving as commander of a machine gun company until May, 1919, when he left the regular Army for the Reserves and returned to California.

In the fall of 1919 the association with Donald R. Dickey began. Dickey had been an invalid following his college years but wrote in 1926 of his subsequent enterprises as follows: (Harris, Condor, 36: 62, 1934) "I awoke about 1916 to find myself a thoroughly husky individual, but too interested by that time in what started as a hobby, to forego it for a conventional business life. . . . When

I came west, Southern California utterly lacked a research museum effort. I was keen about Southern California and about research in vertebrate zoology, and determined to do what I could to further the establishment of a research center in the latter field. In the effort I have built up a study collection of nearly thirty thousand specimens [nearly doubled by 1932, the year of his death] of mammals and birds, with a fair working library. . . . We are now head over heels in the Central American field, and I chafe to be off for my first taste of collecting in the tropical jungles." This was the setting of "the Dickey Institution" and the association Van had with it for 13 years. As far as the ornithological part of the enterprise was concerned, Van was the principal builder and contributor of ornithological data and writings. Dickey supplied the vision, diplomacy, balance, finance, and not an inconsiderable scholarship to the Dickey and van Rossem team, but Van supplied terrific drive, field enthusiasm, intimate life-long acquaintance with birds, and taxonomic sensitivity. The combination of talents was a happy one and as such is recorded by Van in the preface to "The Birds of El Salvador." This book which represented Van's finest effort and which won the Brewster award in 1941, was written entirely by Van who stated: "Since his [Dickey's] death I have gone over the entire paper and have changed it here and there in order to have it accord with his expressed ideas and wishes. For this as well as for personal reasons, it has seemed fitting that Mr. Dickey be regarded as joint [senior] author. That this may serve as a concrete indication of our long and friendly association in ornithological work is my sincere desire."

In this period, beside the many short and preliminary publications basic to the El Salvador report and other long-range undertakings, van Rossem produced such sound and important papers as "A Study of Some Plumages of the Black Tern" (1923), "A Survey of the Song Sparrows of the Santa Barbara Islands" (1924), "The Races of *Sitta pygmaea* Vigors" (1929), and "Critical Notes on Some Yellowthroats of the Pacific Southwest" (1930).

This period was also one of intensive field work in southern California, Baja California, southern Nevada, Sonora, and El Salvador. I had the good fortune as a youngster to spend a whole summer (1922) with Van at Buena Vista Lake, California, as camp helper (can opener) and boatman, and again I worked with him in 1925 and his field colleague, R. A. Stirton, in El Salvador as well as on shorter local trips. Van's assistance to Stirton and to me in learning hunting and skinning techniques was a great help, his command of practical affairs and

obliviousness to vicissitudes an object lesson to a young naturalist, and his zeal and imagination in seeking ornithological data an inspiration. I was proud that he could use my ears as an aid in collaborative hunting and I found him always helpful and considerate to a beginner unless momentarily preoccupied with an ornithological pursuit. The Dickey Institution in Pasadena was a rendezvous when we were not in the field. It drew me as a magnet because of its vigor and the beauty of the collections that were fast building, an attraction it had also for Loye Miller.

During van Rossem's years with Donald Dickey, they repeatedly sought arrangements whereby Van might obtain college training. In 1928 this led to enrollment in Occidental College in Los Angeles. A considerable experience in liberal arts was received over a period of some three years which coupled with his natural skill in languages gave him desirable scholarly background. The technical training in zoology although helpful was not as extensive as he would have desired. Later, in 1948, in recognition of Van's research attainments, Occidental College awarded him an honorary degree of Doctor of Science.

With the death of Donald Dickey in 1932, the Dickey enterprise, then temporarily housed at the California Institute of Technology, was left with no assured future. Financial support was slight and impermanent, and in the uncertain depression years, new opportunities for a professional position for van Rossem seemed non-existent. This situation coupled with the break-up in divorce in 1934 of his first marriage of 1918 to Grace Coolidge created tensions and uncertainties of the most distracting kind. Yet through all this Van continued to produce in research. Encouragement and aid from Clinton G. Abbott of the San Diego Natural History Society helped. And some of his undertakings in the mid-thirties were supported by the Marquess Hachisuka of Japan who for a time was resident in southern California.

Mrs. Dickey maintained minimal support for Van, however, until 1940, at which time a cooperative arrangement was made, chiefly through the interests and efforts of Loye Miller, whereby the University of California at Los Angeles would receive the Dickey Collections and in 1943 would assume full support of them and of van Rossem. In 1940, therefore, the collections were transferred to the University and housed on its Clark Library property, and van Rossem held the title in the University of Curator of the Dickey Collection (later Senior Museum Zoologist) with the added designation of Lecturer in Zoology in 1946 which permitted a limited participation in the

training of advanced students. Not until long after van Rossem's death in 1949 did the tremendously valuable collections, numbering in the order of 60,000 specimens of birds, find adequate fireproof housing on the University campus in Westwood, there to be cared for by van Rossem's successor as curator, Dr. Thomas R. Howell.

The research of the 1930's and 1940's focused more and more on northwestern México. It led to van Rossem's definitive and valuable book on the birds of Sonora, a distributional survey, that was published in 1945. This was part of an even larger program intended to elucidate the faunal relations of birds on both sides of the Gulf of California and of the deserts of the southwestern United States. With the publication of the book on Sonora, this state became the first mainland area of México for which there was a comprehensive digest of literature, field work, and taxonomic and distributional data. In reviewing this report in the *Condor* (1946: 98-99) we noted that van Rossem "on taxonomic matters tends to be a positivist. Consequently . . . he has had to reverse himself on a number of stands which were taken earlier. A saving virtue is the ability to change when new evidence demands."

Initiation of the work on Sonora came through the acquisition by Donald Dickey of large collections made in that state by John T. Wright starting in 1929. Van Rossem's acquaintance with the area began in earnest in the period from 1930 to 1932 with field trips to the Guaymas district and offshore islands. In 1937 he travelled and collected through the length and breadth of the state and even as the report was being concluded and after its publication, up to 1948, he was taking every opportunity for short expeditions to Sonora or bordering areas. Several of these trips were in company with Loye Miller, for whom they were always a source of much pleasure. Van's consideration in helping him to participate in field work for many years after his retirement was deeply appreciated.

The efforts to perfect the taxonomy of Mexican and Central American birds led to a desire on Van's part to examine types and other critical specimens in Europe and especially to work over the wealth of neotropical birds in the British Museum. In 1933 he spent many weeks abroad in these pursuits and he was able to return to Europe in 1938, when he attended the International Ornithological Congress at Rouen, France, as a permanent member of the committee on international ornithological congresses.

The trip in 1933 coupled with work at the Museum of Comparative Zoology at Cambridge, Massachusetts, led to his contribution of 1934 entitled "Critical Notes on Middle American Birds" published in the

bulletin of that museum. This major paper dealt with many taxonomic issues relating to Guatemalan and other Central American birds and included a useful report on the Brewster Collection of Chihuahuan and Sonoran birds. The working up of the Brewster material was fundamental to the solution of problems in Sonora, although the paper dealt largely with the Frazar specimens which subsequently, as later understood by van Rossem, proved unreliable for color work because of some unfortunate method followed by the collector in preserving and preparing the skins. Van Rossem in his work at other museums than his own kept very careful records of types examined and he was generous in supplying details about them to other workers whose decisions hinged on type identifications.

An example of the hasty work alluded to earlier was the outgrowth of the European trip of 1938. A long series of descriptions of new races published in 1938 in the *Bulletin of the British Ornithologists' Club* was not in keeping with Van's powers of discrimination and judgment displayed in his best publications. Whether these descriptions were done in haste because of limited time in England or under some heavy drive to describe new forms, which for the moment gripped him, the result generally was not a happy one.

In 1939 he again had opportunity to go to Europe through the award of a Guggenheim Fellowship. The trip was unfortunately shortened by the onset of war but he did get to Paris, Brussels, Leiden, and various cities in Germany, as well as to London.

Among the more distinguished and substantial contributions of the years when the Sonoran work was foremost were van Rossem's "Birds of the Charleston Mountains, Nevada" (1936) which was noteworthy for its zonal and ecological information, and "A Synopsis of the Savannah Sparrows of Northwestern Mexico" (1947). In the last years of his life he was pressing forward with a revisionary study of the Screech Owls of the Sonoran province pursued with the interest and collaboration of Loye Miller, the two men having spent much time in night hunting for critical material from 1944 on. This work was interrupted short of manuscript stage by van Rossem's death on September 4, 1949, but his efforts were not entirely lost in this matter as his assemblage of specimens and partial record of viewpoints were the basis for further study and report in 1951 (A. H. Miller and L. Miller) on this group of birds. Likewise unfinished was a revised treatment of the Birds of Baja California on which Van worked determinedly in checking literature and specimens in his last year between illnesses. The spark of interest in this job buoyed him up, and while hospitalized he spoke optimistically of its early completion, an event which only he could have seen through.

Van Rossem's sons of his first marriage, Donald Richard (Dick) and (Adriaan) Peter, as well as their mother and Van's mother survive him. Although they never participated in Van's scientific studies, they were rightly proud of his professional attainments. In 1934 Van married Florence S. Stevenson and in 1944, following her death, Dorothy Sanderson. Dorothy Sanderson had been interested in the Dickey enterprises and had worked for Donald Dickey in the 1920's. Her death in 1946 was another tragic personal chapter in Van's life, for there was a strong community of interest in natural history between them, even though poor health prohibited Dorothy Sanderson's participating in field work.

Honors came to van Rossem as his mastery of subject and his abundant publications made him widely known in ornithological circles. Beside the Brewster Award, the Guggenheim Fellowship, and other recognitions earlier noted, he was elected a Fellow of the American Ornithologists' Union in 1934 and a member of the Council in 1946. In 1944 he served as President of the Southern Division of the Cooper Ornithological Club and continued thereafter on the Board of Governors of this Society, serving likewise a term on its Board of Directors concerned with business of the Corporation. In 1937 he was elected a corresponding member of the Sociedad de Biología de México.

Thus appropriately recognized was a career of unswerving devotion to ornithology that overrode many difficult periods of family loss and professional uncertainty. In the later years in spite of experiences that doubtless afforded basis for bitterness, there was notable in Van an increasing attitude of kindness and helpfulness toward colleagues and graduate students at the University of California at Los Angeles, as indeed toward those less immediately associated. These were a reflection of character which, combined with his drive, enthusiasm, and achievement, inscribe the monument to this colorful man.

Museum of Vertebrate Zoology, Berkeley, California, August 15, 1956.

PIGMENTATION OF EGGS: VARIATION IN THE
CLUTCH SEQUENCE

BY F. W. PRESTON

THE material herein reported upon comprises a collection of some twenty clutches of eggs of the Laughing Gull (*Larus atricilla*) collected in 1952 from the saltings east of Stone Harbor, New Jersey, being the same collection that was analyzed for *shape* in a previous report (Preston and Preston, 1953), and a collection of twenty-two clutches, of three eggs each, of the Common Tern (*Sterna hirundo*), collected in 1953 from the high-level sand-flats south of Stone Harbor, being the same collection analyzed for *shape* in another previous report (Gemperle and Preston, 1954). Some reference is made briefly to a small, and inadequate, collection of eggs of the Least Tern (*Sterna albifrons*) collected in 1953 south of Stone Harbor and north of Anglesea, New Jersey.

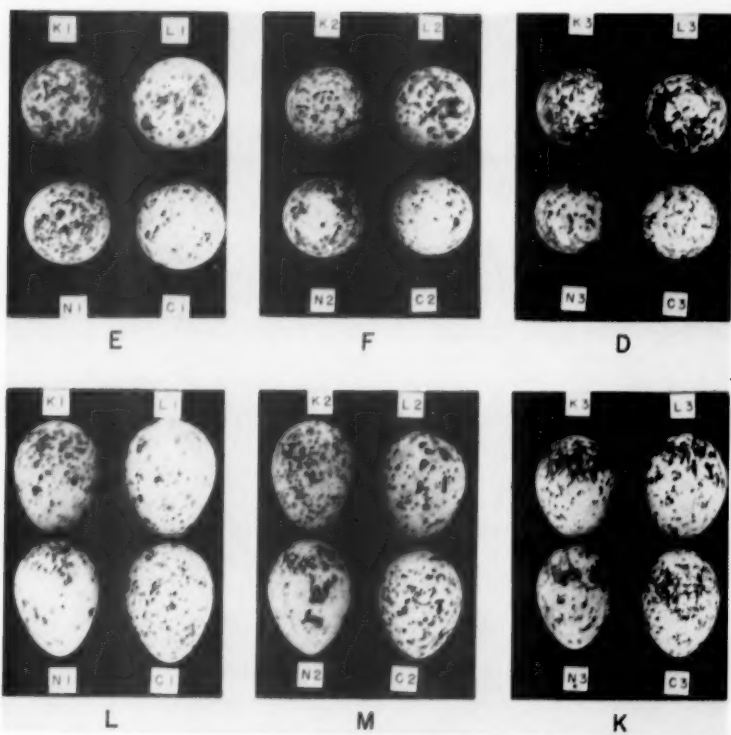
It was observed, as these eggs were collected, that the last egg typically differed from the others not only in shape but also in pigmentation. It seemed advisable to report on this, but pigmentation does not lend itself so readily to exact quantitative description as shape does. Apparatus was developed to try to describe the arrangement of pigment on a quantitative basis, but since the results are capable of fairly satisfactory treatment on the basis of personal judgment, a method we have used with success in other fields, especially when several individuals expressed independent judgments, the present paper reports briefly on that basis. This appears the more desirable, since no apparatus was developed for assessing the *shape* of the individual spots, and though such an apparatus is imaginable, it was not made.

In Plate 2, Figure D shows an axial view of four terminal (third in a clutch of three) eggs of the Laughing Gull, showing how definitely the spots are arranged in a wreath or crown with a bare center. Figure E shows the four "first" eggs of the same clutches, and Figure F shows the four "second" eggs.

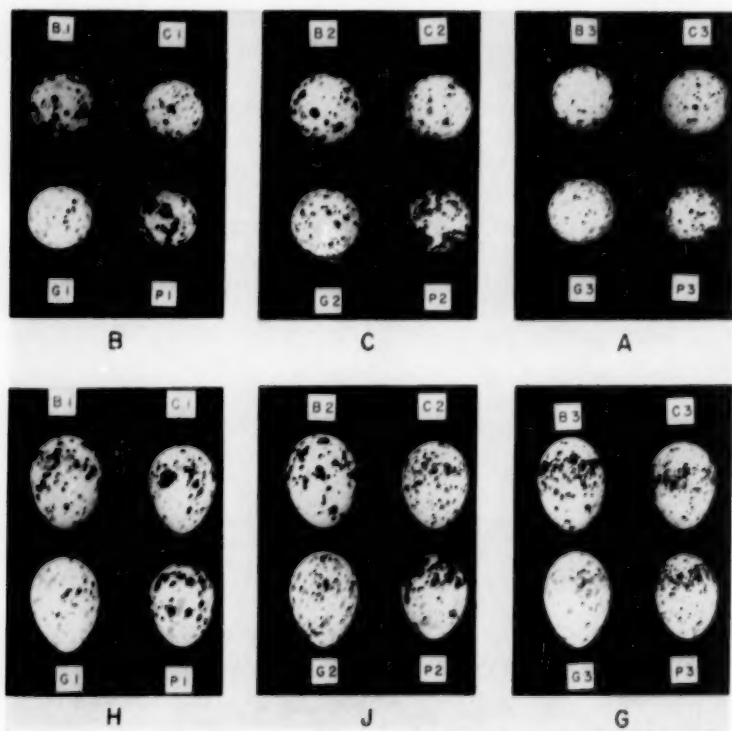
In Plate 3, Figure A shows an axial view of four terminal eggs of the Common Tern. Figure B shows the corresponding "first" eggs, and Figure C the corresponding "second" eggs.

Not all nests show the phenomenon so clearly, but it is frequent enough that it is worth some brief discussion.

In Plate 2, Figure K shows the more conventional aspect (profile view) of the same terminal eggs of the Laughing Gull. Figure L shows



EGGS OF THE LAUGHING GULL. (E) Paraxial and (L) profile views of the first eggs in clutches K, L, N, and C. (F) Paraxial and (M) profile views of the second eggs of the same clutches. (D) Paraxial and (K) profile views of the third (terminal) eggs of the same clutches.



EGGS OF THE COMMON TERN. (B) Paraxial and (H) profile views of the first eggs in clutches B, C, G, and P. (C) Paraxial and (J) profile views of the second eggs of the same clutches. (A) Paraxial and (G) profile views of the third (terminal) eggs of the same clutches.

the corresponding first eggs, and Figure M the corresponding second eggs.

Figures G, H, and J do for the Common Tern what Figures K, L, and M do for the Laughing Gull.

It will be observed, most easily in the conventional views, and more especially in the Laughing Gull eggs, that many of the "spots" are elongated, vermiform markings, and that this is particularly the case with the terminal eggs.

The present paper is concerned with the question whether there is a significant difference between the first, second, and third eggs in respect either of the vermiform nature of the markings or the tendency of the spots to form a definite "wreath." The fact that sometimes the spots are uniformly distributed and sometimes tend to form wreaths has been a matter of occasional comment for generations past. So far as I know, the variation has not previously been ascribed to the position of the egg in the clutch-sequence.

Since the judgments reported below are subjective, it was thought advisable to use as observers persons having no great knowledge of birds' eggs or the results expected, but otherwise of high intelligence and trained scientific minds. It is not to be expected that two or more observers will agree closely with one another, but it *is* to be expected that each observer will be reasonably *self* consistent. If several observers were used, it would be necessary to run an "analysis of variance" on the findings, to discover how much of the variation was due to observers and how much to eggs. This seemed too ambitious a project in the present instance. In the case of the first observer reported below, all the Laughing Gull eggs were presented to her once (some sixty of them) and seventeen of them were presented twice without her knowledge. She was quite consistent on her ratings of these seventeen eggs.

LAUGHING GULL EGGS

(a) How much of the overlay-pigmentation consists of spots and blotches, and how much of "scribble-marks"?

The observer was Mrs. Effie Young, a graduate chemist: the interviewer was Miss Mary Gemperle, also a graduate chemist. The test material in the first test consisted of fifteen clutches of three eggs each, known to be complete clutches, of the Laughing Gull. The eggs were presented one at a time, with no comparison material available, and the order was random. As previously mentioned, seventeen of the eggs were presented twice, with very good consistency. Table 1 summarizes the results.

TABLE 1
LAUGHING GULL EGGS. PROPORTION OF SPOTS AND SCRIBBLES

Position in the Clutch	<i>Mrs. Young's Estimates (in per cent)</i>		Standard Deviation
	"Spots and Blotches"	"Scribble Marks"	
First	84.2	15.8	27.6
Second	67.3	32.7	37.2
Terminal	16.9	83.1	23.3

Note: The Standard Deviations here reported have little real meaning, because the distribution is not Gaussian, and in some cases three-quarters of the total variance is contributed by a couple of non-conforming eggs, so that in the absence of these two eggs, the standard deviation would fall to one-half its value.

The same observer now operated in the same fashion on four clutches of two eggs each, from nests that were left long enough to make sure that no third egg was going to be laid. Table 2 summarizes the results.

TABLE 2

Position in Clutch	<i>Observer's Report (in per cent)</i>	
	"Blotches"	"Scribble Marks"
First	94.5	5.5
Terminal	63.7	36.3

This group is too small for satisfactory statistical analysis. So far as it goes, it suggests that the terminal egg of a two-egg clutch resembles the second egg of a three-egg clutch rather than the terminal egg of a three-egg clutch. This is rather surprising in view of our (1953) finding that the terminal egg of a two-egg clutch resembles in *shape* the terminal egg of a three-egg clutch, not the second egg thereof.

A second observer, Mr. R. Daum, a college student with no knowledge whatever of previous work on the subject, was tested by myself (FWP) some twelve months after the test of Mrs. Young. The eggs were presented in random order, and the test was repeated using another random order. Frequently the observer repeated his estimate exactly, but differences of five or ten percentage points were common, larger deviations being rare. Table 1A gives the outcome.

The results for the two-egg clutches are given in Table 2A. Again each egg was presented twice. The test was actually made by mixing

TABLE 1A

LAUGHING GULL EGGS. PROPORTION OF EQUIAXIAL SPOTS AND BLOTCHES
(IN PER CENT). MR. DAUM'S ESTIMATES ON THREE-EGG CLUTCHES

<i>Position in Clutch</i>	<i>First Test</i>	<i>Second Test</i>	<i>Average Result</i>	<i>Mrs. Young's Estimate</i>
First	81.0	85.8	83.4	(84.2)
Second	72.1	77.6	74.8	(67.3)
Third	30.6	31.4	31.0	(16.9)

TABLE 2A

LAUGHING GULL EGGS. MR. DAUM'S ESTIMATES (IN PER CENT)

<i>Position in Clutch</i>	<i>Proportion of Spots and Blotches Average of Two Tests</i>	<i>c.f. Mrs. Young's Estimates</i>
First	80	94.5
Second	77	63.7

the eggs in with the three-egg clutches, but the results are reported separately.

It is clear that the "personal equation" has come into play in a somewhat consistent fashion: the two observers have interpreted either their instructions, or their observations, somewhat differently. They agree, however, on all essential points, viz., that the third egg differs greatly from the other two in pigmentation: that the second differs a little from the first, in the direction of adumbrating what the third will be like: that in a two-egg clutch (so far as our small sample shows) the second egg tends to resemble the first rather than the second, contrary to its behavior in the matter of *shape*.

(b) Do the spots, blotches, and scribble-marks form a recognizable crown or wreath? How well developed is it?

Table 3 reports Mrs. Young's findings on this point.

TABLE 3

WREATH FORMATION

<i>Fifteen Three-Egg Clutches</i>		<i>Four Two-Egg Clutches</i>	
First Egg	Mere trace of a wreath	First Egg	Trace
Second Egg	More definite trace	Second Egg	Trace
Third Egg	Fairly well developed		

Thus in this respect also the second egg of a three-egg clutch is nearer to the first egg than it is to the third egg, a phenomenon that

persists in all aspects both of pigmentation and of shape. Here, too, however, so far as the very small sample goes, there is evidence that in the matter of pigmentation, whether we are dealing with vermiform markings or wreath formation, the last egg of a two-egg clutch is not "terminal" in character, but rather resembles the first egg, which is *not* true of its shape.

COMMON TERN EGGS

The literary efforts of the Common Tern are much less noteworthy than those of the Laughing Gull. On its third egg the Gull puts a lot of scribbling, while the Tern puts comparatively little. None the less, there are occasional scribbles and a definite tendency to elongated spots. The Tern's first egg has the spots typically well distributed and also separated. In the second egg there is more of a tendency for the spots to aggregate into clumps or blotches, but the individual spots, when separable, are still essentially equiaxial. In the third egg not only is there a tendency for the blotches to agglomerate into a single wreath, but the spots themselves seem often to be elongated.

The observer this time was Mrs. Preston and the interviewer was myself.

This is the same collection of sixty-six eggs, twenty-two clutches of three eggs each, collected near Stone Harbor, New Jersey, in May, 1953, whose shape was the subject of a previous report (Gemperle and Preston, 1954). I presented them one at a time to Mrs. Preston, who was required to rate them according to the following scale:

- 0—"I cannot see any trace of a wreath"
- 1—"I might persuade myself there is a trace"
- 2—"There definitely is a tendency towards a wreath"
- 3—"The wreath is unequivocal"
- 4—"The wreath is conspicuous and immediately obvious"

Mrs. Preston says she had a psychological difficulty in making the distinction between (3) and (4), so it must be assumed that her highest rating would average about 3.5.

The order of presentation was substantially random, but subject to the requirement that every egg be presented once and none twice. She did not see the identity-marks of the eggs, so her judgment must be assumed reasonably unbiased, probably much more so than if I had made the ratings. The results are given in Table 4.

TABLE 4

COMMON TERN EGGS. PIGMENTATION. OBVIOUSNESS OF WREATH.
MRS. PRESTON'S RATINGS

Clutch	Sequence			Clutch	Sequence		
	1	2	3		1	2	3
A	2	0	4	L	4	0	3
B	0	1	3	M	0	3	2
C	1	2	4	N	1	2	3
D	0	0	0	P	0	2	4
E	0	0	3	Q	0	0	0
F	1	2	3	R	0	0	1
G	0	0	4	S	0	0	1
H	0	0	4	T	0	1	2
I	0	0	2	U	0	0	0
J	1	4	4	V	0	1	3
K	0	2	0	W	0	0	2

The averages (\bar{x}) and standard deviations (σ) of a single observation are as follows:

Egg No. 1: 0.45 ± 0.93 Egg No. 2: 0.91 ± 1.17

Egg No. 3: 2.36 ± 1.45

"Student's" *t*-test may be applied to these results, and the outcome is as follows:

Between the first and second egg there is not a significant difference ($p = 75$ per cent).

Between the second and third egg there is a very significant difference ($p > 99.9$ per cent).

Between the first and third egg there is a very significant difference ($p > 99.9$ per cent).

Since the eggs are known to be in clutches of three and the identity is known, a partition of variance might be more logical than a *t*-test, but because the ratings are not actual measurements this refinement was not adopted. In this connection it may be noted that almost half the total rating of the "first" eggs occurs in clutch L, where there is indeed a conspicuous arrangement of the spots into a ring, but this appears to be a fortuitous ring, not an organic one, like that of L3. I myself would probably have rated L1 much lower than 4 points, because the individual spots in the ring are equiaxed, not vermiform in the slightest, and quite free from "scribbling" or linear marks, which is not the case with L3.

QUANTITATIVE ESTIMATES OF THE DISTRIBUTION OF PIGMENTATION

The methods so far outlined in this paper represent subjective judgments of unbiased observers. In other fields we have found such techniques often surprisingly consistent and very useful, but most ornithologists and other men of science would prefer quantitative information, and some would prefer instrumental information.

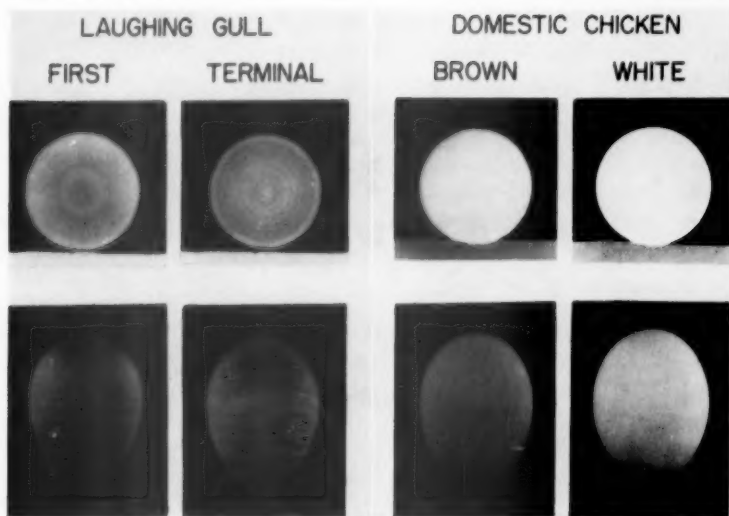
One method by which quantitative results could be obtained is this: we might mount the egg in such a way that it can rotate on its axis, and we might draw real or imaginary pencil lines on it to represent "parallels of latitude." Then we could measure quantitatively how much of a given parallel passes through dark spots and how much is over relatively light background or "ground-color." If this were done for a sufficient number of parallels and for a sufficient number of specimens, we could report a distribution curve of (spot) pigmentation characteristic of the first, second, and third eggs of a sequence.

A modification of this might consist in taking photographs and ruling pencil lines on the photographs.

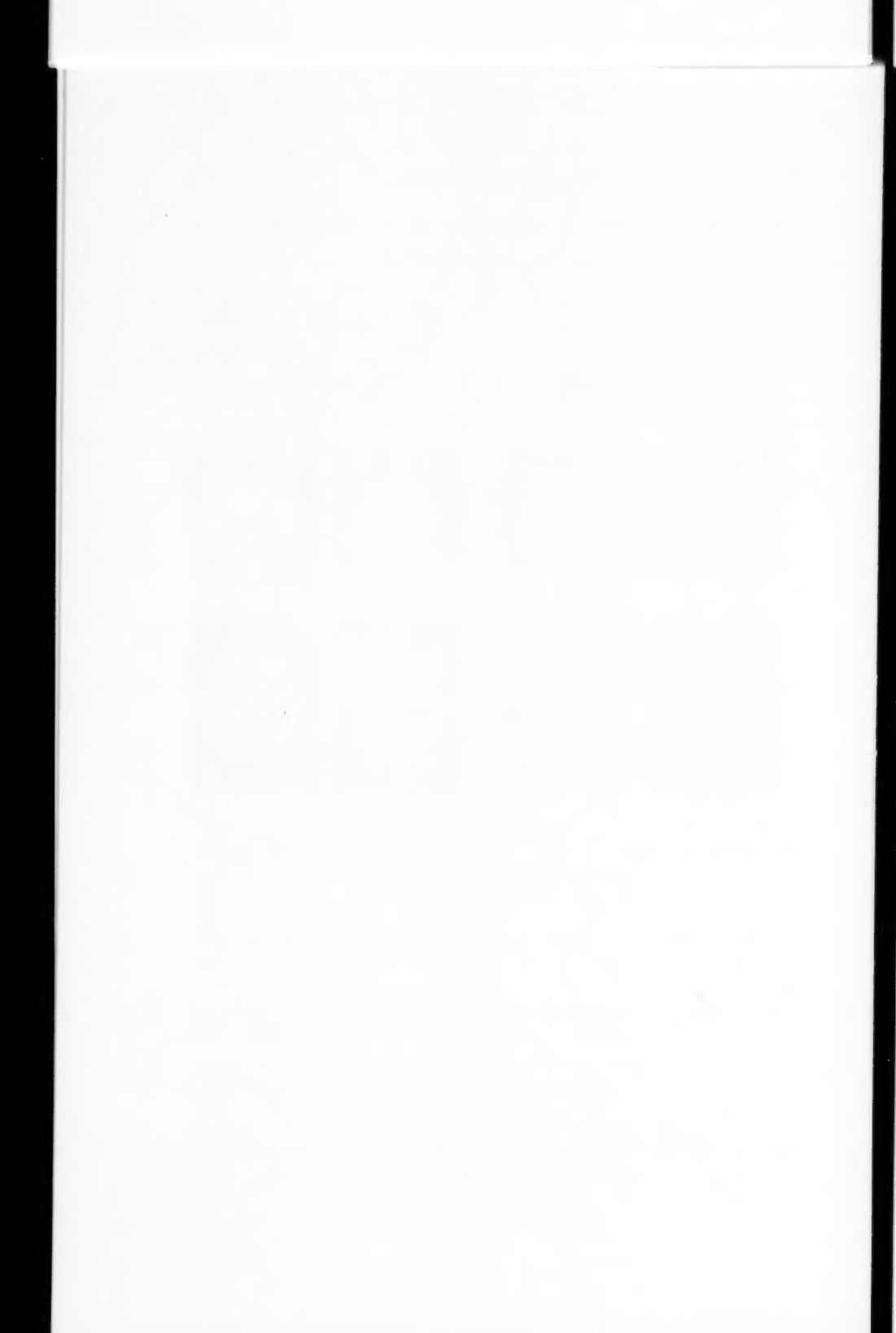
Such methods are time-consuming but might very likely prove quite accurate. What we actually did was somewhat more ambitious, and somewhat less easily reduced to an absolute measure of pigmentation, but theoretically capable of greater accuracy.

Pigmentation Profiles of Eggs.—These were obtained as follows: four clutches of Laughing Gull eggs that showed well the differences between pigmentation of the first and last eggs, viz., clutches K, L, N, and C, were chosen (these are the same that are illustrated in the "still" pictures), and the first and last eggs of the clutch were used. A special device had been made that permitted us to mount the egg, supported only by a tiny area at the small end, with its axis vertical and big end up. After the egg had been "trued up" so that its own axis coincided closely with the axis of the device, it was rotated at constant speed around this axis by a small gear motor, the egg making about one revolution per second. The egg was illuminated by a somewhat elaborate system of lights, translucent diffusing screens, and matt reflecting screens, so as to destroy all obvious "high lights," and make the egg appear uniformly illuminated all over. This uniformity was sufficient for visual purposes, but, photometrically, truly uniform illumination is perhaps impossible and was not achieved here. The background was black velvet, out of focus.

The camera, the gear motor, the illuminants, the screens and accessories were mounted in a specially-made apparatus, so that the same positions, degree of illumination, distribution of illumination,



PARAXIAL (*top*) AND PROFILE VIEWS OF ROTATING EGGS. Left to right, a composite photograph of the first eggs in clutches K, L, N, and C of the Laughing Gull; a composite photograph of the third (terminal) eggs of the same clutches; and brown and white eggs of the domestic chicken.



and so on could be accurately recovered, in spite of the necessity for taking photographs horizontally and vertically, and in spite of the necessity for changing eggs. Although absolute perfection was not obtained, we believe that the photographs can validly be compared with one another to illustrate the points of the present paper.

The purpose of rotating the egg was to smear out individual spots into a circular ring, as seen from above along the direction of the axis, or into a horizontal band as seen from a horizontal position. When egg K_1 had been photographed, L_1 was substituted and without moving the camera or film, its image was photographed on top of that of K_1 . Then N_1 and C_1 followed, so that we had a composite picture of all four eggs, the total exposure being divided equally among them. The final result is an averaging out of the individual spots of all four eggs. One photograph was taken vertically (axially) and consists of a pattern of diffuse circular rings. A second was taken horizontally, and shows the outline of an egg, with a pattern of horizontal bands. See Plate 4.

The same experiment was repeated for the third eggs of the same clutches, viz., K_3 , L_3 , N_3 , and C_3 . In addition we obtained negatives of a white chicken egg and a brown chicken egg, of substantially the same size. All told we now had eight negatives.

These were taken to the Physics Department of the University of Pittsburgh, where Dr. T. M. Donahue and Dr. W. M. Benesch ran transmission curves on an automatic Leeds and Northrup microdensitometer. The curves were generally obtained in duplicate, by running the instrument both forward and backward across the film, and the results agreed extremely well, and showed a great deal of detail. This detail is irrelevant to our purposes and appears to represent an ability on the part of the instrument to pick out the traces of many individual spots, in spite of the rotation. It seems also to have detected, in the longitudinal "profile" views, the hole through which the egg was blown, since this is, photometrically, essentially a black spot.

Figure 1 shows the curves obtained from the (negative) photographs of the profiles (longitudinal views) of rotating eggs. A is for a brown egg of a domestic chicken, B is an average, or composite, of four "first" eggs of the Laughing Gull, and C represents the terminal eggs thereof.

Since the detail is somewhat beside the point in the present paper, we give in Figure 2 a smoothed-out version of these curves, emphasizing the major features.

Microdensitometer curves were run also on the paraxial photo-

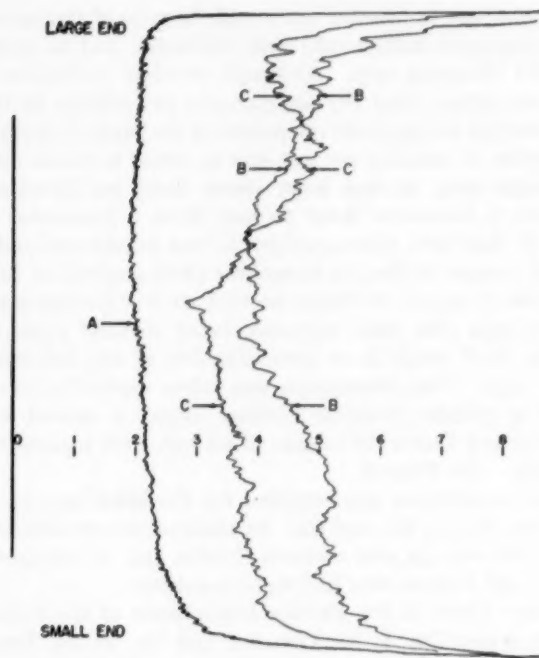


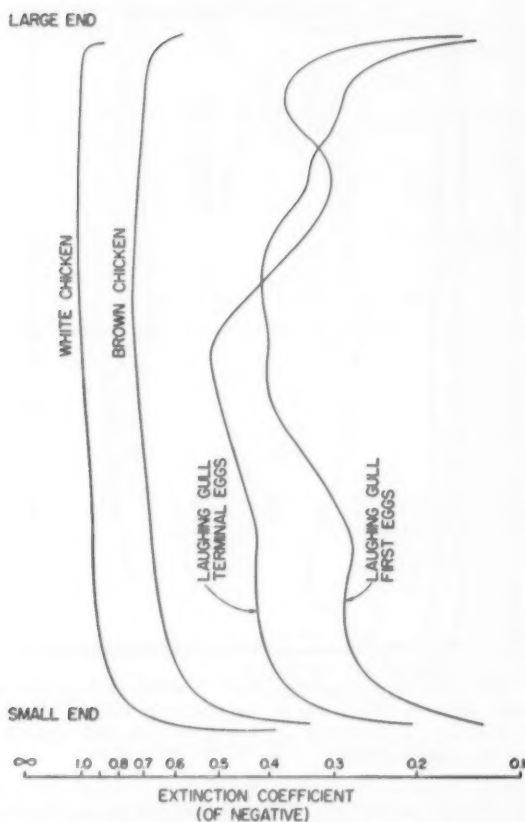
FIGURE 1. Microdensitometer curves from top to bottom of the longitudinal profiles of rotating eggs. A. Brown egg of the domestic chicken. B. Composite of the first eggs of clutches K, L, N, and C of the Laughing Gull. C. Composite of the third (terminal) eggs of the same clutches.

graphs, and some of these are shown in Figure 3, while the smoothed-out versions are given in Figure 4.

The scale of intensity which the instrument actually records is a little complicated. What the microdensitometer actually measures is the amount of *blackening* in the *negative* of the egg. It does this by passing a fine pencil of light through the negative and measuring the fraction of the light that is *transmitted*. Thus if I_0 is the original intensity, i.e., the intensity of light in the complete absence of the photographic film, and if I is the intensity that is transmitted, what we record is the fraction I/I_0 . This has the value of zero if the negative is absolutely black and opaque, and the value unity if the negative is absolutely transparent.

For many physical measurements, it is convenient to work with the "extinction coefficient," which we may call " z ," and the instrument is calibrated in these terms. The scale at the foot of Figures 2 and 4 is a scale of z . Its relation to the transmission is given by

$$I/I_0 = e^{-z} \quad \text{or} \quad \log_e (I/I_0) = -z \quad (1)$$



MICRODENSITOMETER CURVES, LONGITUDINAL PROFILES

FIGURE 2. The same curves as in Figure 1, but simplified and smoothed out, and the curve for a white egg of a domestic chicken added.

<i>Extinction Coefficient</i>		<i>Per Cent of Light Transmitted</i>
For example, if	$z = \infty$	$I/I_0 = 0$
	$z = 1.0$	36.8
	$z = 0.8$	44.9
	$z = 0.6$	54.9
	$z = 0.4$	67.0
	$z = 0.2$	81.9
	$z = 0.1$	90.5

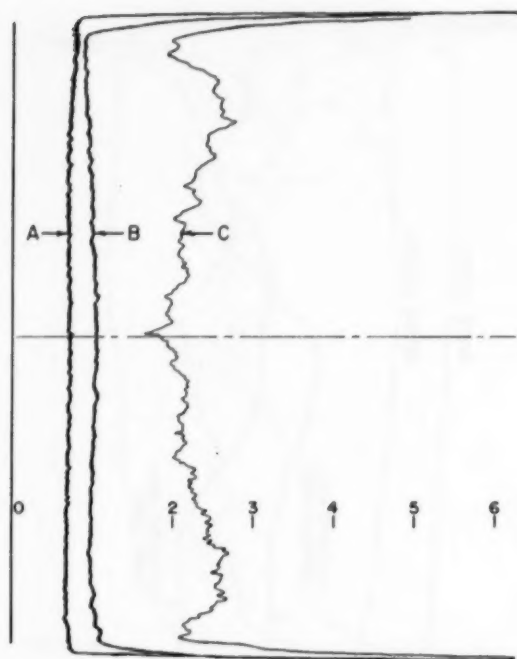
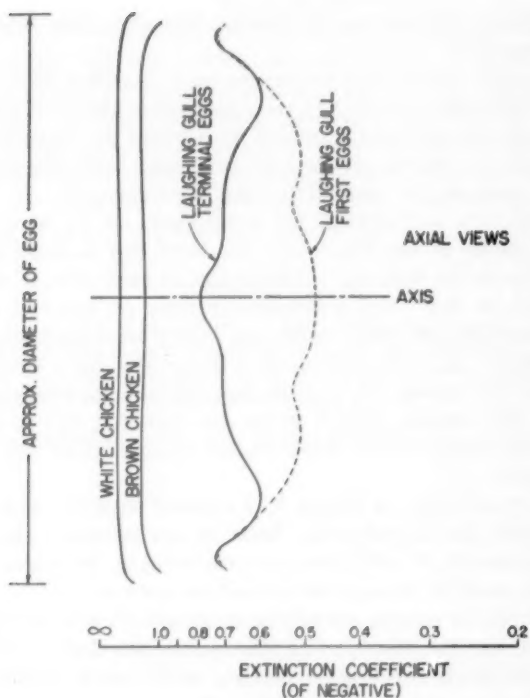


FIGURE 3. Microdensitometer curves from paraxial photographs of the large ends of rotating eggs. A. White egg of the domestic chicken. B. Brown egg of the domestic chicken. C. Composite of the third (terminal) eggs of clutches K, L, N, and C of the Laughing Gull.

The fraction of light transmitted through the *negative* is the fraction that would be blocked by a perfect *positive*, and hence, subject to all the peculiarities of the photographic process, is an indication of the intensity of pigmentation of the eggs. The relationship, as we have said, is not simple, and in particular is not a direct measure of the number or size or concentration of spots; for the spots themselves are not absolutely black, the background is far from being white, and the illumination is not absolutely even, nor identical in the axial and profile views.

The important point is that the various eggs may be compared with one another with some approach to quantitative accuracy. The further the curve moves to the right, the greater the degree of pigmentation of the egg.

Note that at the extreme margins (the margins of the circle in the axial view and the top and bottom in the profile view) there are two further sources of inaccuracy. First, the eggs, though rotating nearly true on their axis, did not rotate absolutely true, and secondly, the eggs are not all of absolutely identical size, so that, where com-



MICRODENSITOMETER CURVES, AXIAL VIEWS

FIGURE 4. The same curves as in Figure 3, but simplified, smoothed out, and corrected for light distribution. A smoothed-out graph for the first eggs of clutches K, L, N, and C of the Laughing Gull is added.

posite or "average" pictures are involved (and this means all rotating gull egg pictures), we were sometimes photographing eggs and sometimes black velvet.

Referring now to Figures 2, 3, and 4, it is clear that while the brown chicken egg is somewhat "darker" than the white egg, the Gull eggs are considerably darker than the chickens'. But what is more interesting is the fact that on the whole the curve for the "last" eggs of the Laughing Gull lies to the left of the curve for the "first" eggs. This means that it is markedly less pigmented, a point that no one had noticed by visual observation. We knew that the spots were arranged differently and that the individual spots were of a

different shape, but had not recognized that there was substantially less total pigment.

We may note further that the curves cross, and that there is a zone where the third egg is markedly *more* pigmented than the first. This zone extends (as seen in side view) from about one-eighth to about one-third of the length of the egg, measured from the blunt end. This is the zone of the "wreath" around the large end.

Referring next to Figure 4, the axial view, we see that over the "pole" or center of the blunt end, the third egg is much lighter in pigment than is the first egg. This is due, in part at least, to the egg being "bald on top" and substantially freer of spots in this area than the first egg, but presumably the background may also average a little lighter. A curious thing, if it were valid for a large number of eggs and not merely for four, is that the last egg tends to show a dimple in the extreme center where the first egg shows a definite bulge. This might have a physiological interpretation and not be a mere accident.

Once more referring to Figure 2, it appears possible, after allowing for the slightly less illumination "south of the equator," that there is a trace of a wreath, in both first and terminal eggs, but more definitely in the first, south of the equator as well as north of it.

The samples, of course, are not large enough to warrant any broad conclusions, and the above notes merely indicate that a quantitative tool is available for much more detailed examination of the intensity of pigmentation and its distribution than is possible from visual inspection.

I wish to acknowledge the help of Professor T. M. Donahue and Professor W. M. Benesch, both of the Physics Department, University of Pittsburgh, in running the microdensitometer curves; the help of Mr. T. R. Schuerger of the Preston Laboratories in preparing the negatives from which the curves were made, and the *negatives* of Plates 2 and 3; and my wife's help in the field with the eggs and in the Laboratory typing and experimenting. The *positives* were prepared by Mr. Paul Wolfe, of Butler, in all cases. The tracings from which Figures 1 to 4 were made were prepared by Mr. R. R. Lehnerd, of the Laboratory.

SUMMARY

In our own collections of the eggs of Laughing Gulls and Common Terns, and probably somewhat generally with these species and some others, the last egg of a clutch of three tends to show a very definite "wreath" or "crown" of spots circumscribing the large end

of the egg: that is to say, the spots are arranged in a belt "north of the equator" of the egg, but leaving the "north pole" area, the big end of the egg, essentially free from spots, while the first egg of a clutch tends to have the spots uniformly distributed all over the egg. The second egg tends to be intermediate but more nearly resembles the first than the third. Further, as is particularly evident in the Laughing Gull, the individual spots tend to be equiaxed in the first egg, but elongated into sausage-shaped marks and even "scribbles" in the third egg.

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Preston Laboratories, Box 149, Butler, Pennsylvania, March 6, 1954.

COWBIRD PARASITISM OF THE
NORTHERN YELLOW-THROAT

BY P. B. HOFSLUND

DURING the summers of 1948 through 1951 I made an intensive study of the life history of the Yellow-throat (*Geothlypis trichas*). The summers of 1948 and 1949 were spent in studying a population near Ann Arbor, Michigan, and the study was continued in 1950 and 1951 at Duluth, Minnesota. An important part of the study was the relationship between the Yellow-throat and the Cowbird (*Molothrus ater*).

Amount and Type of Injury to the Host.—Twenty nests, or about 38 per cent of the Yellow-throat nests found in the four-year study, were parasitized by the Cowbird, and only three of these nests produced any Yellow-throat young. Almost 58 per cent of the total egg loss of the Yellow-throats studied could be attributed to the Cowbird. Thirty-three per cent of this egg loss was due to the removal of host eggs, 20 per cent to punctured eggs, 13 per cent to nest desertions caused by Cowbird activity, and 33 per cent to the loss of heat to the larger Cowbird eggs. This information is summarized for each year in Table 1.

TABLE 1
INJURY TO THE YELLOW-THROAT BY COWBIRD PARASITISM

	1948	1949	1950	1951
Total number of Yellow-throat nests found	18	20	8	6
Number of Yellow-throat nests parasitized	7	11	1	1
Yellow-throat eggs known laid	59	50	30	13
Egg loss	18	18	10	6
Egg removal attributed to Cowbird	2	8	0	0
Punctured eggs attributed to Cowbird	3	1	2	0
Eggs lost through nest desertion caused by Cowbird activity	3	1	0	0
Eggs abortive, loss attributed to loss of heat to Cowbird eggs	3	6	0	1
Total egg loss attributed to Cowbird	11	16	2	1
Percentage of egg loss attributed to Cowbird	61.1	88.8	20.0	16.6

I was never fortunate enough to see the removal of an egg by a Cowbird. I have assumed, therefore, on the basis of the laying of Cowbird eggs after or before the host eggs disappeared and the well-authenticated proof that Cowbirds do remove host eggs established by Hann (1937: 204, 1941: 211-221), that the ten host eggs and three

Cowbird eggs that disappeared from nine nests were removed by the parasite. There were other instances where, undoubtedly, host eggs were removed which do not enter into these figures. For instance, one nest, when found, contained two Cowbird eggs and two Cowbird young, but no host eggs or young. Undoubtedly, Yellow-throat eggs were removed, but just how many is questionable. Considering both host and parasite eggs, the number of eggs removed from the nest was equal to 81 per cent of the total Cowbird eggs laid. This compares to Hann's (1937: 204) findings of 85 per cent in his Oven-bird study.

Some of the host eggs left in the nest showed tiny punctures in the shell of a type and shape apparently caused by the claws of the Cowbird. There has been some disagreement as to whether punctures of this type are accidental or deliberate, and whether they are caused by the nails or the mandibles (Norris, 1947: 88). The size and the shape of the punctures I found in Yellow-throat eggs fitted the claws better than they did the mandibles, and I feel, as did Friedmann (1929: 186), that such punctures are caused by the claws of the Cowbird when the clumsy female tries to place herself on a nest too small for her. I found seven of these punctured eggs during the investigation, and none of them hatched.

Four nest desertions were attributed to Cowbird activity at the nest. Two nests were undoubtedly deserted because the contents of an egg leaked out on the other eggs through the punctures caused by the Cowbird. At another nest the Cowbird laid eggs before the Yellow-throat eggs were laid, and at a fourth nest it seemed likely that the removal of several eggs may have caused desertion.

There was a direct relationship between the hatching success and the number of Cowbird eggs laid in the nest. No more than two Cowbird eggs, or one Cowbird egg and two Yellow-throat eggs hatched in any nest; and if more than one Cowbird egg was present, no Yellow-throat eggs hatched. This relationship held true for all parasitized Yellow-throat nests under observation, and apparently, as indicated by the number and kinds of young, it was true also in broods out of the nest for which nests were never found. Roughly, the heat of incubation each Cowbird egg received was enough to prevent the hatching of two Yellow-throat eggs.

Hann (1947: 174) estimated that the probable limit of egg volume that an Oven-bird can hatch successfully was between 1.3 and 1.8 times the volume of the normal five-egg clutch, and that it was probably nearer 1.3 than 1.8. The normal Yellow-throat clutch is four (Hofslund, 1953: 69), and although five-egg clutches are not un-

common, frequently only four of the five eggs will hatch. Using Schönwetter's formula (Nice, 1937: 113) and average measurements for the Yellow-throat and Cowbird eggs examined during the study, I calculated the average volume of a Yellow-throat egg to be near 1.7 cc. and that of a Cowbird egg to be near 3.1 cc. The volume of a normal four-egg clutch would thus be approximately 6.8 cc.; of two Cowbird eggs 6.2 cc., or almost the same volume as the four-egg Yellow-throat clutch. The replacing of two Yellow-throat eggs by two Cowbird eggs would bring the total volume to 9.6 cc., or 1.4 times the normal egg volume. While these figures are calculated and have not been tested in the field, the number of Yellow-throat-Cowbird broods I have observed which had the relationship previously mentioned seems to indicate that 1.3 times the normal clutch volumes closely represents the limit of egg-volume that a Yellow-throat will normally hatch, and ordinarily one can say that a nest with more than one Cowbird egg in it is doomed to failure as far as the Yellow-throat eggs are concerned.

Shaver (1918: 10) blamed the failure of a Yellow-throat egg to hatch on a Cowbird egg-shell that had slipped over it and adhered there. Hann (1937: 204) found that this type of accident had no effect on the hatching of the Oven-bird egg. My findings bear out Hann's conclusion. I observed three instances of the half-shell of a hatched Cowbird egg slipping over the smaller Yellow-throat egg. In one case the shell was removed by the adult Yellow-throat and the egg hatched. In the second instance I removed the shell, but despite what I considered as help, the egg failed to hatch. In the third instance the shell remained and the egg failed to hatch. The evidence seemed to indicate that the Cowbird egg-shell did prevent the hatching of the latter two eggs, but when the contents of these two eggs were examined they were found to contain embryos that had not progressed beyond the 4 to 5 mm. stage, indicating death of the embryo long before the adherence of the Cowbird half-shell. Shaver made no mention of the Yellow-throat egg being pipped, and as the contents of the egg were not examined, the embryo may have been dead before the shell adhered to it.

In the Ann Arbor region, Yellow-throats normally raised two broods a season. If an attempt was unsuccessful they tried again. These attempts continued until at least one was successful, or presumably, physiological changes prevented further effort. One pair of Yellow-throats in the study made at least three and perhaps four attempts before they were finally successful in raising a brood, which in this case consisted of two Cowbirds. Theoretically, a pair of

Yellow-throats should raise from seven to ten young a season. The raising of Cowbirds only, however, satisfies the physiological urge to raise young. Thus if the first attempt at raising a brood produces nothing but Cowbirds, one Yellow-throat brood is lost, and only one more attempt will be made. If this also should produce only Cowbirds, it is still a successful attempt as far as the parents are concerned, and no further effort will be made. Therefore, Cowbird interference under these condition has caused the loss of from seven to ten Yellow-throats. In areas such as Duluth where only one brood is normally raised, it is conceivable that a heavy Cowbird year could cause serious inroads on the population.

The above instances are all concerned with egg loss. I found no loss of nestlings that could be attributed to the Cowbird with the possible exception that Cowbird nestlings seem to be more noisy than Yellow-throat nestlings, and there is the possibility that predators might be attracted more to nests containing Cowbirds than to those that have Yellow-throat nestlings alone.

The Cowbird may hatch from one-half to one day earlier than the Yellow-throat, and usually they remain in the nest from one-half to one day after the Yellow-throats leave, thus exposing the parent birds over a longer period to the attendant dangers of the nesting cycle.

There were no losses of young Yellow-throats during the four years of study from suffocation or starvation, and Yellow-throats in parasitized nests developed at about the same rate as did those in unparasitized nests.

The Cowbird is an important check on the Yellow-throat population, but it does not seem to be a critical factor, as witness the fact that although the incidence of parasitism was relatively high, the reproductive success of the Yellow-throats during the four-year study was slightly better than 51.9 per cent. One important factor here was that only rarely were cases of parasitism found that occurred after the first part of July. Second and third attempts were generally free of Cowbird parasitism. In Duluth, where only one brood was raised, the breeding season of the Yellow-throat normally is enough later than the Cowbird's that the relative frequency of parasitism usually is quite low.

Success of the Cowbird in Yellow-throat Nests.—At least 75 per cent of the parasitized nests contained more than one Cowbird egg (Table 2), the most common number in a single nest being two, and with an average of 2.0 per parasitized nest, a figure comparable to the 1.8 average found by Stewart (1953: 113) in his Yellow-throat study.

This is apparently a high percentage when compared to other passerine victims. Friedmann (1929: 178) found that only 33 per cent of over 9000 passerine nests had more than one Cowbird egg; Nice (1937: 156), 30 per cent of 98 Song Sparrow nests; Norris (1947: 89), 38 per cent of 73 passerine nests; Hann (1937: 202), 55 per cent of 22 parasitized Oven-bird nests; and Berger (1951: 33), 52 per cent of 112 passerine nests.

TABLE 2
DISTRIBUTION OF COWBIRD AND YELLOW-THROAT EGGS IN
PARASITIZED YELLOW-THROAT NESTS

Number of eggs Yellow- Cow- throat bird	First nesting					Subsequent nestings				
	Number of nests					Number of nests				
	1948	1949	1950	1951	Total	1948	1949	1950	1951	Total
5	3						1			1
4	2	1			1					
3	2	1	1		2		1			1
3	1	1			1					
2	3		1		1					
2	2	2		1	3		2			2
2	1		2		2	1				1
1	2				1	1	1			2
0	2		1		1					
0	4						1			1
Average number of Cowbird eggs per nest:										
	1.8	1.8	2.0	2.0	1.8	1.5	2.5			2.2
Average number of Cowbird eggs laid in the 20 parasitized nests:										2.0

The Cowbird received as good care and solicitude as the Yellow-throat nestlings. The Cowbird hatched after an average of 11.6 days of incubation, a figure similar to that found by Hann (1937: 204) and Norris (1947: 95), and the young did not leave the nest normally until the ninth day after hatching. They required roughly a week less care before reaching independence than did the Yellow-throats. Their enemies must be considered the same as the host, and that must include the adult Cowbird, too. Parasite eggs as well as host eggs were removed, and sometimes the physiological urge to lay eggs produced rather strange and, for the Cowbird, unfortunate results. One Cowbird female laid an egg in a depression left after I removed a deserted Yellow-throat nest. Another laid in a nest that already had eggs incubated for 11 days, and still another laid in a nest that had been deserted for two weeks.

TABLE 3
SUCCESS AND MORTALITY OF COWBIRDS PARASITIZING YELLOW-THROAT NESTS

	1948	1949	1950	1951
Yellow-throat nests parasitized	7	11	1	1
Per cent of total nests parasitized	38.8	55.0	12.5	25.0
Cowbirds eggs laid in all nests	12	24	2	2
Cowbird eggs hatched	4	12	0	1
Per cent of Cowbird eggs laid that hatched	36.3	50.0	0.0	50.0
Cowbirds fledged	3	8	0	1
Per cent of eggs hatched producing fledglings	75.0	66.6	0.0	50.0
Loss of Cowbird eggs				
Number of eggs lost	7	12	2	1
Removed by Cowbirds	1	2	0	0
Predation	0	2	0	0
Infertile or abortive	1	5	0	1
Desertion	5	4	2	0
Loss of Cowbird nestlings				
Number of nestlings lost	1	4	0	0
Predation	1	4	0	0
Average number of Cowbird eggs per parasitized nest	1.07	2.18	2.0	2.0
Average number of fledglings per parasitized nest	0.42	0.72	0.0	1.0

When we compare the success of the Cowbird eggs with that of the host's, we find that the per cent of Cowbird eggs hatched was less than that of the Yellow-throat, 42.5 per cent as compared to 65.8 per cent. Nice (1937: 163) had a ratio of 63.7 per cent Cowbird eggs hatching to 60.7 per cent Song Sparrow eggs. Only nine of the 20 parasitized nests produced Cowbird fledglings (Table 3) an average of 1.3 Cowbirds per successful nest, but only 0.6 per cent Cowbirds per parasitized nest. The Yellow-throat, therefore, can be considered as only a fairly favorable host.

SUMMARY

The Cowbird, a frequent parasite of the Yellow-throat, is moderately successful with this host. It acts as an important check on the Yellow-throat population, with most of the damage it does to the host coming during the egg stage of the nesting cycle, when it may cause loss of host eggs through deliberate removal, accidental punctures, causing of nest desertion, and loss of the heat of incubation, that normally would go to the host egg, to the parasite eggs.

This paper is a part of a thesis submitted to the University of Michigan in partial fulfillment of the requirements for the degree of Doctor

of Philosophy. The work was done under the direction of Dr. H. W. Hann.

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EVOLUTION IN THE GENUS *MYZOMELA*
(AVES: MELIPHAGIDAE)

BY KARL F. KOOPMAN

In recent years many genera of birds, particularly of Polynesia and the Malay Archipelago, have been analyzed in terms of geographical distribution, speciation, and intra-generic evolution. Much of this work is discussed by Mayr (1940, 1942). The importance of these investigations in terms of evolutionary mechanisms has been ably summarized by Mayr and Moynihan (1946: 1). "As has been demonstrated in many recent papers, the knowledge of the systematics of birds has reached such a degree of completion, that it can be used safely as a basis for studies on evolution. Island birds are particularly favorable material for such studies, because each water gap acts as a barrier reducing population movements and gene flow. Subspecies found on a series of neighboring islands often show character progressions which one might expect in a fossil series but hardly in contemporary geographical representatives. It appears in some of these cases as if each colonization of a new island was correlated with a certain amount of evolutionary change." On the same page a number of genera of birds are mentioned as containing some of the most interesting cases of incipient and recently completed speciation, one of these being *Myzomela*. I have selected the genus *Myzomela* for study largely because geographical variation in the form of conspicuous color patterns is readily detected in most species in the genus.

The genus *Myzomela*, as here discussed, consists of a number of small, mostly rather brightly colored, honeyeaters (Meliphagidae), ranging from Celebes, Sumba (Lesser Sundas), and northwestern Australia, to Samoa, and from the northern Marianas Islands to southeastern Australia. They occur on almost all islands within this area, but in Australia they are found only in the well-watered regions of the northern and eastern coasts. They almost certainly form a natural group, but further taxonomic work on the honeyeaters may show that other forms should be added to the genus. In this case, the forms here discussed should be considered a subgenus of the larger genus *Myzomela*. This larger genus might or might not contain, among others, the species *pectoralis* and *niger*, by many considered to belong to the genus.

An attempt will be made in this paper to trace the relationships within the genus, the pattern of distribution, and something of the pattern and mode of evolution in connection with certain definite

plumage color characters. Though it doubtless has had an important bearing on evolution within the genus, differential selection exercised by the ecology in various parts of the range will not be discussed. Plumage color was selected as a means toward elucidating these evolutionary problems, inasmuch as in most other respects the various forms are very similar. Body size is rather untrustworthy, often differing considerably among closely related forms, yet being very similar among distantly related ones. (The wing length in the genus ranges from 49 mm. in *adolphinae* to 79 mm. in *cardinalis rubrata*.) In this study I have paid particular attention to the distribution of red and black in the plumage and to the degree of sexual dimorphism, including secondary masculinization of the female plumage, as these characters could be most easily analyzed throughout the genus. No attempt has been made to pass on the validity of the various subspecies which have been described.

Adequate material of all forms was examined with the exception of the following races: *cruentata coccinea* (none), *obscura mortyana* (type only), *cardinalis tucopiae* (type only), *pulchella* (1 male), *erythrocephala dammermani* (1 male), *nigrita ramsayi* (1 male), *obscura rubrobrunnea* (1 male), *cardinalis kurodai* (2 males), *nigrita pluto* (3 males), *cruentata kleinschmidti* (2 immature males, 1 female), *obscura aruensis* (3 males, 1 sex?), and *blasii* (5 males, 1 immature). For the particular purposes of this study, a series of a given form containing at least 1 adult of each sex was considered adequate, since individual variation in this genus is usually slight as shown by large series (over 50), which were available for several forms.

GENERAL SURVEY OF THE GENUS

In order to facilitate the tracing of relationships among the species here treated, they are grouped into three sections, based mainly on the presumed primary presence or absence of sexual dimorphism, but also, to some extent, upon color patterns in both sexes. A check-list of the species and subspecies is given in the appendix and the probable phylogeny is indicated in Figure 1.

Section I.—This section is characterized by a presumed primary absence of sexual dimorphism, both sexes being predominantly gray or brownish, in some cases with a more or less diffuse reddish tinge. Really bright spots of color, if present, are restricted to red on the throat. The members of this section are all of fairly large size. The general gray coloration prevalent in this section suggests that it is the most primitive in the genus.

The four subspecies of the more or less primitive *obscura*, namely

harterti, *obscura*, *aruensis*, and *fumata*, resemble each other closely, being grayish-brown and lacking more than traces of red on the throat. *M. o. simplex* and *o. mortyana* are also similar, but show traces of red on other parts of the body. Finally, in *o. rubrotincta* and *o. rubrobrunnea*, there are distinct, though somewhat dull, red areas on the back, wings, and tail, and a less distinct reddish "wash" elsewhere. A red plumage is apparently here acquired by a diffuse reddening rather than by spread from well-defined centers.

M. albigula is closely related to *obscura*, but the plumage is somewhat lighter and streaked with gray-brown. Traces of red appear

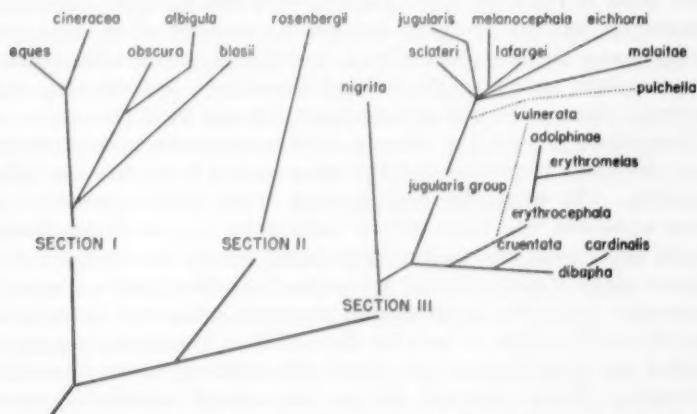


FIGURE 1. Phylogeny of the species in the genus *Myzomela*. Relationships indicated by dotted lines are extremely tentative.

on the throat, and in the case of the pale subspecies, *a. pallidior*, also on the forehead.

M. eques resembles *obscura* very closely except for having a bright red throat patch. Its three races are all very similar and have no red on the forehead.

M. cineracea is very similar to *eques*, but is grayer and has only slight traces of the red throat mark. This virtual absence of red may be secondary.

M. blasii resembles *a. pallidior* more than any other form, having faint traces of red on the throat and forehead. However, it also has a slight greenish-yellow wash over the body, and the throat and upper breast have a scaled pattern. It occupies a somewhat uncertain phylogenetic position.

It may be said that were it not that *eques* and *obscura fumata* live

side by side in southern New Guinea, all the forms of the *eques-obscura* group, which make up Section I, with the possible exception of *blasii*, would probably be considered conspecific. From the known characters, however, I am unable to group these five species even into two or more superspecies.

Evolutionary History of Section I.—The initial splitting-up of the *eques-obscura* group probably took place in the Pleistocene, before the last (Würm) glaciation. At this time, as Zeuner (1942) has pointed out, south-central New Guinea was an island, separate from the main New Guinea land mass. Zeuner believes that during at least some of the interglacial periods, even this southern island was submerged, but this probably was not the case for all of them, particularly not the last (Riss-Würm) interglacial, which represented a less complete retreat of the ice and therefore a less complete submergence than in the case of the second (Mindel-Riss) glaciation.

Somewhere within the general Moluccan-southern New Guinea area, Section I originated and the *eques-obscura* group became differentiated. The originally homogeneous stem form apparently became separated into three isolated subspecies, one on Seran (*blasii*), which never gave rise to any other form, one on the southern New Guinea island ("*obscura*") and one on northern New Guinea ("*eques*"). Somewhat later the northern and southern subspecies or incipient species each gave rise to another distinct form, the northern going to Umboi and New Britain (*cineracea*), the southern to the Louisiades (*albigula*). More recently, *obscura* has spread to the Moluccas, Biak, and Australia, where it has given rise to several more or less distinct subspecies. With the establishment of a land connection between northern and southern New Guinea, *eques* and *obscura* invaded each other's territory to some extent. Since, however, during the period of geographical separation, they had acquired reproductive isolation, they now live side by side as good species, though morphologically rather similar. *M. eques*, however, has a greater altitudinal range, probably owing to the more varied topography of the former north New Guinea island.

Section II.—This section contains only *r. rosenbergii* and *r. longirostris*, which differ only in the longer bill of the latter. Though sexual dimorphism has been developed in this species, the female plumage is quite different in appearance from that found in Section III, and hence *rosenbergii* is placed in a separate section. The head of the female is mottled black and brown; this is unique in the genus. The throat is black in both sexes, and neither sex has any red on the head, though red is present on the breast and rump in both, and on

the neck and back in the male. It may be noted that this is the first case to be mentioned here of melanization in *Myzomela*, as all parts not red in the male are black. The female plumage probably shows some secondary masculinization by darkening of the head, though this is difficult to determine in the absence of closely related forms.

The limited distribution of this species is probably to be explained by its extreme mountain habitat, widening the geographical barriers which must be crossed and severely limiting the number of nearby islands on which it could subsist. Though the range of the nominate race is considerably broken up by valleys separating the various mountain ranges, it shows no visible geographical variation.

Section III.—This section contains all the remaining forms of the genus and is distinguished from the other two sections by the female plumage. Except when secondarily masculinized, this is very characteristic. It is of a rather neutral olive-gray tone, with the back and belly somewhat yellowish, and shows traces of red on the forehead and throat. In both sexes, red, if present, is usually concentrated on the head, always being present there if it is present anywhere else.

The species of this section fall into four species groups, distinguished by basic differences in color pattern of the males. These are the *nigrita*, *cardinalis*, *cruentata* and *jugularis* groups, which will be discussed in turn.

M. NIGRITA group.—Though the plumage of unmasculinized females of *nigrita* is fairly typical of Section III, the group is in other respects rather different, and apparently more primitive than the other three groups of this section. The males of all but two forms are completely black and bright spots of color, if present, are restricted to red on the crown.

The only deviations from the all-black plumage of the typical male are in some of the island races. The male of *steini* is dark gray rather than black, thus resembling the typical female plumage considerably more than do the males of the other forms of *nigrita*. There are two possible explanations for this. *M. n. steini* may be the most primitive subspecies, in which sexual dimorphism, resulting from melanization, has not been completely developed. Actually both sexes of this race resemble *obscura* considerably except for their much smaller body size. An alternative explanation is that this is a case of secondary feminization of the male plumage (hen-feathering). It is impossible at the present juncture to choose between these alternatives.

The only other modification of the male plumage in this species is

found in *forbesi*. Here the male has a small red crown mark. Young males of *tristrami* have a yellow bill, unlike the black bill found in other subspecies.

The most interesting variation in this species entails the female plumage. In *steini*, *nigrita*, *pluto*, *forbesi*, *louisidensis*, and the western populations of *meyeri*, it is quite typical of Section III. In *tristrami*, *pammelaena*, *ernstmayri*, *ramsayi*, and *hades*, all females are black like the males (cock-feathered), whereas in the eastern populations of *meyeri* both "normal" and black females occur side by side.

The distributional history of *nigrita* seems fairly simple and clear. (See Figure 2.) The species presumably originated on Waigeu or

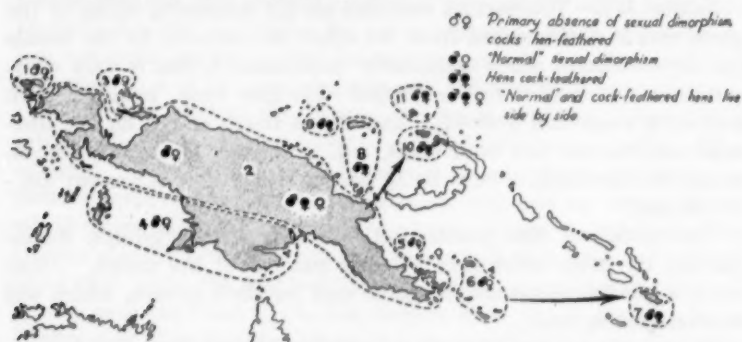


FIGURE 2. Geographical distribution of the subspecies of *Myzomela nigrita*, showing the presence or absence of sexual dimorphism: 1. *steini*, 2. *meyeri*, 3. *pluto*, 4. *nigrita*, 5. *forbesi*, 6. *louisidensis*, 7. *tristrami*, 8. *pammelaena*, 9. *ernstmayri*, 10. *ramsayi*, 11. *hades*.

somewhere in New Guinea, and first spread over New Guinea, Japan, and Mios Num. From New Guinea it spread in two directions: east to the D'Entrecasteaux Islands, Louisiades, and San Cristobal, and north into the smaller islands of the Bismarck Archipelago. In spite of the great similarity in size and coloring between *tristrami* and the races in the Bismarck Archipelago, the absence of members of this group from all the Solomon Islands except San Cristobal makes it seem highly unlikely that there is any direct relationship between the forms of the two areas. They appear rather to represent independent offshoots from the New Guinea subspecies.

M. CARDINALIS group.—This may be considered the central group of the more specialized *Myzomelas* and has by far the greatest range and number of forms, all of which may be included in one superspecies. In this group, the entire head is almost always red in males, the

throat invariably so. The back, rump, and at least the upper part of the breast are also usually red. This wide distribution of intense red pigment is in sharp contrast with the condition met with in the groups hitherto considered. Melanization is quite frequent, but no general reddening of the plumage ever occurs. The *cardinalis* group may be divided into two subgroups according to whether or not the back is red.

In the *cardinalis* subgroup, the back is always red. The two included species differ in that in *cardinalis*, the male plumage is entirely red and black, whereas in *dibapha* the lower abdomen, at least, is whitish or yellowish and the wings may be brown. Another peculiarity of *dibapha* is that each belly feather has a light-colored bar running across it, though this is not clearly visible unless the feather as a whole is red. This character is absent in *cardinalis*. The extent of red on the ventral surface in males is quite variable in both species of this subgroup. It is almost restricted to the throat in *tucopiae*, but covers almost the entire abdomen in *elisabethae*, and there are many intermediate conditions. The distribution of red elsewhere on the body is much more uniform, covering, in all cases but one, the entire head, back, and rump. The sole exception is *chermesina*, in which the forehead, cheeks, and nape are black.

In the *erythrocephala* subgroup, the back is never red, but is black or brownish. Red is also always absent from the abdomen and lower breast, these parts being whitish. Though the absence of red on the back is an important character, this subgroup, particularly *erythrocephala*, resembles the *cardinalis* subgroup so closely in other ways, such as the pigmentation of the head, that it must be considered as representing the *cardinalis* group within its range, and as therefore belonging to the same superspecies.

M. erythrocephala, especially *e. kuehni*, resembles *dibapha* except for the important subgroup characters. *M. adolphinae* is also very similar except for its much smaller size (smallest of all *Myzomelas*), and for the red on the breast being even more restricted to the throat. In both these species the females have unmasculinized plumage. The males of *adolphinae* show little melanization, but the various races of *erythrocephala* show great variation in this respect, *kuehni* being lightest and *dammermani* darkest. *M. erythromelas* is somewhat similar to *adolphinae*, but melanization of the male plumage is very pronounced. Not only does black cover all parts not red, thus resembling *cardinalis*, but even the red area has been restricted to the head. The female plumage shows considerable masculinization.

M. vulnerata is a doubtful member of the *cardinalis* group. It re-

sembles *erythrocephala* somewhat but is darker than any of the races of *erythrocephala*. The female plumage is almost completely masculinized. Red is present on the nape in both sexes, but not on the forehead, cheeks, and back, these being black. In this way it resembles the *jugularis* group more than it does the *cardinalis* group.

Evolutionary history of the cardinalis group.—The *cardinalis* group, as here constituted, almost certainly originated somewhere in the Banda Sea area, since the most primitive members of both subgroups occur there. Here the initial splitting-up into subgroups took place, probably at a time when New Guinea was divided into northern and southern islands. The *erythrocephala* subgroup apparently reached the southern New Guinea island quite early. *M. adolphinae* was apparently at first only a north island subspecies of the south island *erythrocephala*. Taking advantage of the new upland habitat afforded, *adolphinae* became a mountain species. *M. erythromelas* apparently developed as a New Britain offshoot of *adolphinae*. Since the union of the north and south New Guinea islands, two races of *erythrocephala* (*erythrocephala* and *infuscula*) have invaded the general range of *adolphinae*, the two species living in close proximity, but retaining the extreme lowland habitats in which they evolved, these forms of *erythrocephala* have not really overlapped the range of the mountain form. Besides New Guinea, *erythrocephala* has also colonized Wetar (perhaps its center of distribution), Australia, and from the northwest coast of the latter continent, Sumba.

M. vulnerata of Timor poses a special problem. If its range were unknown, it would undoubtedly be put into the protean *jugularis* group, with which it agrees very well. However, between Timor, the habitat of *vulnerata*, and Karkar, the nearest island within the range of the *jugularis* group, lies the whole stretch of the Arafura Sea and New Guinea, uninhabited by any closely similar forms. It therefore appears more likely that *vulnerata* has evolved its *jugularis*-group-like characters independently from a form like *erythrocephala*. The extreme diversity in appearance among the various members of the *jugularis* group, the considerable masculinization of their females, together with the extreme masculinization of the female plumage in *vulnerata*, makes the problem more difficult of solution. Whether this form reached Timor from Wetar, New Guinea, Sumba, or Australia, is unknown.

The *cardinalis* subgroup, represented by its primitive species, *dibapha*, first spread in two directions. The first was north and west into the Moluccas and Celebes, giving rise to several well-marked races; the second, south and east, past territory perhaps only later occupied by the *erythrocephala* subgroup, to eastern Australia. From

Australia, *dibapha* invaded New Caledonia and also gave rise to *cardinalis*. *M. cardinalis* probably arose in the Loyalty Islands and spread through the New Hebrides to the Santa Cruz Islands. Samoa was also invaded, as were Rennell and San Cristobal. From San Cristobal, *cardinalis* reached Micronesia, spreading widely in the



FIGURE 3. Geographical distribution of the species and subspecies of the *cardinalis* group in relation to the *jugularis* group, showing coloration of the forehead, nape, back, and rump: 1. *vulnerata*, 2. *erythrocephala kuehni*, 3. *e. dammermani*, 4. *e. derbyi*, 5. *e. erythrocephala*, 6. *e. infusata*, 7. *adolphinae*, 8. *erythromelas*, 9. *dibapha eva* (Jampea, Selayar), 10. *d. juga* (South Celebes), 11. *d. chloroptera* (North Celebes), 12. *d. batjanensis*, 13. *d. wakaloensis* (Buru), 14. *d. elisabethae* (Seran), 15. *d. boiei* (Banda), 16. *d. annabellae* (Babber, Timorlaut), 17. *d. stephensi*, 18. *d. dibapha*, 19. *d. caledonica*, 20. *cardinalis lifuensis*, 21. *c. cardinalis* (southern New Hebrides), 22. *c. tenuis* (Efate, northern New Hebrides, Banks), 23. *c. lucopiae*, 24. *c. nigriventris*, 25. *c. sanctaecrucis*, 26. *c. pulcherrima*, 27. *c. sanfordi*, 28. *c. rubrata*, 29. *cardinalis chermesina*, 30. *c. dichromata*, 31. *c. major*, 32. *c. saffordi*, 33. *c. kurodai*, 34. *c. kobayashi*.

Caroline and Marianas islands. There seems to be little doubt that *c. chermesina* reached Rotuma from the eastern Carolines, probably Ponape. The distribution of the members of the *cardinalis* group is shown on Figure 3.

M. CRUENTATA group.—Two groups occupy a somewhat uncertain position in relation to the *cardinalis* group but may be offshoots of it. Certainly they are more closely related to it than to *nigrita*.

The first is the *cruentata* group containing only the species *cruentata*.

It is distinguished from the other species of Section III by the fact that in males practically the entire plumage is red. In this character, *cruentata* is similar to the Moluccan-Biak races of *obscura*, these being the only other forms of *Myzomela* with red tails. In *obscura*, however, no well-defined patches of red were present, so that reddening was diffuse and never led to the entire plumage acquiring a bright color. In *cruentata*, on the other hand, bright red was probably already present on the belly, breast, rump, back, and entire head, as in a form such as *cardinalis elisabethae*, since the red in the New Guinea form of *cruentata* appears to be more intense in those areas. All that was then necessary for a completely bright red plumage to develop was an extension of red to the wings and tail.

In *c. cruentata* the red color is very bright but still seems concentrated on the belly, breast, back, and rump. As one goes through *kleinschmidti* and *coccinea* to *erythrina*, the red becomes duller and more diffuse, thus approaching the Moluccan-Biak races of *obscura* in appearance. The females of *c. cruentata* have a fairly typical feminine plumage of the Section III type, but this becomes considerably masculinized in the transition to *erythrina*.

M. cruentata apparently originated in western New Guinea as an offshoot of some Moluccan race of *cardinalis* such as *elisabethae*. It has spread all over the hill forest of New Guinea and Japan and up into the Bismarck Archipelago.

M. JUGULARIS group.—This group, all to be included in one super-species, is much more heterogeneous in appearance than any of the others. Hardly any positive characters distinguish the entire group, which can be recognized only by resemblances among the various forms belonging to it. None, however, have red backs, which are present in *cruentata* and in many of the members of the *cardinalis* group. With the exception of *pulchella*, tentatively placed here, none of the forms of this group has red on the forehead and cheeks. The female plumage always shows considerable masculinization.

M. eichhorni is a fairly typical member of the group. Red is confined to the throat and rump in males, the breast and belly being dirty yellow, the rest of the plumage olive to black. The three races differ chiefly in the general shade of color of the non-red areas, *e. eichhorni* being lightest and *e. atrata* darkest, melanization here progressing by a general darkening of the plumage, rather than by extension of black areas. The female plumage is considerably masculinized, this again being least in *e. eichhorni*, greatest in *e. atrata*. In some males of the latter race, traces of red appear on the nape. Whether red is here being lost or gained is difficult to say.

In *lafargei*, red is confined to the nape in males, the throat and dorsal parts being black, the breast and belly yellow. *M. melanocephala* is rather similar to it, but lacks red on the nape, whereas the yellow extends onto the back. Inasmuch as two such similar species as *obscura* and *eques* live side by side without interbreeding, it seems best to recognize *lafargei* and *melanocephala* as distinct species. The absence of red on the throat in these two species is certainly secondary. In both species the female plumage is considerably more masculinized than in *e. eichhorni*, less so in *lafargei* than in *melanocephala*.

Perhaps the most melanistic species of the group is *malaitae*. In its completely black and red coloration, it resembles *cardinalis* so much in general appearance, that it was originally described as a subspecies of *cardinalis*. However, though the abdomen, breast, throat, and rump are red, the forehead, nape, and back are black. Although red may be lacking from any of these parts in various members of the *cardinalis* group, red is never absent from all three, whereas this condition is common in the *jugularis* group. The female plumage is considerably masculinized, to about the same degree as in females of *cardinalis* from nearby islands.

In *jugularis*, as in *malaitae*, the throat and rump are red, but here the nape is also red, whereas the red on the breast and abdomen is replaced by bright yellow. The female plumage is almost completely masculinized, more so than in any other species of this group. This species also has the smallest body size of its group.

In *sclateri*, red appears on the throat and breast, the belly being yellow, the dorsal parts blackish. The female is partially masculinized.

M. pulchella is a very aberrant species. Red is confined to the forehead, cheeks, breast, and throat. It is a very doubtful member of the *jugularis* group, but resembles *sclateri* in general appearance more than any other form. It is the only member of the genus in which the forehead and cheeks, but not the nape, are red.

Evolutionary history of the jugularis group.—The original home of the *jugularis* group is uncertain, but was probably one of the islands to the northeast of New Guinea, perhaps in the Solomons. Unless *vulnerata* is a member of it, this group would appear to have remained always to the north and east of New Guinea. Whether any member of it ever inhabited the New Guinea mainland is unknown. Certainly its range seems small considering the number of very distinct forms which it contains. The group did manage, however, to spread over most of the Solomon Islands and even to the Fijis. It may be noted that although the *jugularis* group resembles the *cardinalis* group less,

perhaps, in basic color characters than does *cruentata*, it has, unlike the latter species, a completely allopatric distribution in relation to the *cardinalis* group. Indeed, all the diverse forms of the *jugularis* and *cardinalis* groups, different though many of them are from one another, replace each other as perfectly as subspecies of one species. *M. adolphinae* inhabits the mountains of New Guinea, *erythromelas* those of New Britain, but *pulchella* occupies only New Ireland, and *sclateri* only small islands off the coasts of New Guinea and New Britain. *M. cardinalis* occupies the New Hebrides, Samoa, the Santa Cruz Islands, Rennell, San Cristobal, and Rotuma; *malaitae* replaces it in Malaita, *melanocephala* on Guadalcanal, *jugularis* in the Fijis.



FIGURE 4. Geographical distribution of the species and subspecies of the *jugularis* group in relation to the *cardinalis* group, showing coloration of the throat, forehead, nape, back, and rump: 1. *pulchella*, 2. *sclateri*, 3. *lafargei*, 4. *melanocephala*, 5. *e. eichhorni*, 6. *e. ganongae*, 7. *e. atrata*, 8. *malaitae*, 9. *jugularis*.

Yet two such similar forms as *eques* and *obscura fumata* live side by side without any interbreeding. This interlocking of the ranges of the *cardinalis* and *jugularis* groups is shown in Figure 4.

As mentioned above, *malaitae* resembles *cardinalis* most closely in general appearance, but in its basic color characteristics it fits best into the *jugularis* group. These facts might be interpreted as showing relationships to both groups, a sort of link between the two. The origin of *cardinalis* is quite clear. It is rather obviously a specialized offshoot of *dibapha*. The origin of the *jugularis* group is, on the other hand, very obscure. It might then be postulated that the *jugularis* group arose from *cardinalis*, *malaitae* being an intermediate form, a race of *cardinalis* which had acquired most of the diagnostic characters of the *jugularis* group. It is very doubtful, however, that the very

diverse *jugularis* group is actually younger than *cardinalis* which, though having more geographical forms, is much less diverse. It is much more likely that the *jugularis* group is an older one, whereas *cardinalis* is a more recent invader into adjoining areas and has not had time to differentiate to any great extent. According to this view, *cardinalis* and *malaitae* developed their color resemblances independently by the extension of red and black pigmented areas over the entire plumage, perhaps in a parallel fashion. By chance, some of the more advanced races of *cardinalis* reached islands close to Malaita. In those races the female plumage happens to be at a stage of masculinization roughly comparable to that found in most forms of the *jugularis* group, particularly *malaitae*. In the general discussion an alternate explanation will be suggested.

GENERAL DISCUSSION

Following this survey of the characters and distribution of the various sections, groups, and species of *Myzomela*, certain conclusions may be drawn regarding the probable common ancestor of the various forms, as well as the general pattern of evolution in the genus. This will help to relate the facts concerning separate forms to the general evolutionary scheme.

Since, at present, New Guinea has the richest *Myzomela* fauna (7 species), it seems likely that it lies near the ancestral range. At least the initial stages in the splitting-up of the genus into sections and groups apparently occurred when New Guinea was divided into northern and southern islands, though just how long ago this began seems impossible to say. Such a situation in New Guinea would appear to offer ample opportunity for the early speciation, especially since the Moluccas and Timorlaut were probably involved, at least in a minor way.

By a comparison of the course of evolution in the various groups, it can be said that the ancestral *Myzomela* was probably of a nondescript gray, without any bright spots of color, without any extensive black areas, and without much sexual dimorphism. Such a state of affairs, relatively unchanged, is found in the Australian and New Guinea races of *obscura*, in *blasii*, *albigula*, *cineracea*, and *nigrita steini*. The typical female plumage of Section III is also not very different from this. It would seem to be the sort of pattern from which the various other plumage patterns could be most easily derived.

Dispersal.—It may now be asked, what evidence do the various living forms give concerning the modes of distribution and speciation prevalent in the genus? From the presence of *Myzomela* on such

clearly oceanic islands as Samoa and Rotuma, and in Micronesia, it is evident that no land bridges are necessary to explain the distribution. Indeed, one of the most striking things about the dispersal of *Myzomela* is the ability of these nectar-sucking birds to traverse wide expanses of open ocean to colonize isolated islands. Thus we have the invasions of San Cristobal from the Louisiades (*nigrita*), eastern Australia from Timorlaut (*dibapha*), and Samoa from the New Hebrides (*cardinalis*). The longest transoceanic invasions are of the Fiji Islands from Malaita by *jugularis* (1200 miles) and Rotuma from Ponape by *cardinalis* (2000 miles). It is not surprising, with such means of dispersal, that practically every ecologically suitable island within its general range has been colonized by one form or another. That successful colonization is often a random matter, however, is shown by the complete absence of *Myzomela* from such islands as the Trobriands, Kei Islands, Sula Islands, Halmahera, and most of the Lesser Sunda Islands.

Geographical speciation.—The question then arises as to whether speciation in *Myzomela* has occurred chiefly on continents or on groups of islands. This much can be said. Whenever two or more subspecies of one species occur on a continent or large island, like Australia or New Guinea, they are very similar, as, for example, the races of *eques*, the New Guinea races of *nigrita*, etc. Island races may also be very similar, as, for example, many of the races of *cardinalis*, the insular races of *nigrita*, etc. There are other cases, however, in which races or closely related species on different islands of a group are very different, such as the members of the *jugularis* group, *cardinalis chermesina* and the other races of *cardinalis*, the Moluccan-Biak races of *obscura* and its other races, etc. Hence it is highly probable that speciation has occurred mainly through isolation on islands.

Borderline cases.—If *Myzomela* is a genus in which active speciation is still proceeding, we would certainly expect to find some borderline cases, forms which, especially using ordinary taxonomic techniques, one finds difficult or impossible to decide to call distinct species or only subspecies of one another. Actually this is a common phenomenon in *Myzomela*, as might be gathered from the above accounts of the various forms. The forms within the following five groups apparently represent borderline cases (the forms in parentheses are ordinary subspecies of the others): 1. *albigula* (with *pallidior*), *obscura* (with *harterti*, *aruensis*, and *fumata*), *simplex* (with *mortyana*), *rubrobrunnea*, *rubroincta*; 2. *eques* (with *nymani* and *primitiva*) and *cineracea* (with *rooki*); 3. *erythrocephala* (with *infuscata*, *derbyi*, *dammermani*, and *kuehni*) and *adolphinae*; 4. *chermesina* and the other races of *cardinalis*;

5. *lafargei* and *melanocephala*. In some of these, the forms have been considered distinct species, in others, subspecies; but, to a large extent, the designation has been rather arbitrary. In all cases, I tried to compare the differences between the doubtful allopatric forms, with those present between sympatric species, particularly between the closely related *eques* and *obscura*, where the differences, aside from the presence or absence of the red throat mark, are very slight, since this was the only case of sympatric forms within the same group. The validity of these decisions, however, depends upon a parallel evolution of morphological differences and reproductive isolating mechanisms throughout the genus. There is no positive evidence either for or against this assumption, but of course no exact correlation would be expected.

Hybridization.—In a genus like *Myzomela* with such excellent facilities for dispersal, yet which is broken up into so many distinct forms, one might expect to find numerous hybrid populations. This is tied up with the problem of the possibility of hybridization in *Myzomela* between forms considered distinct species. However, such hybridization appears to be rather rare. There is only one place where it seems reasonably certain that hybridization between rather distinct forms occurs. That is between *nigrita tristrami* and *cardinalis pulcherrima* on San Cristobal, the only place where these two species occur together. The two forms are very similar in size, but strikingly different in color pattern. Here, however, the hybrids are rather rare (one probable and one doubtful hybrid as compared with 15 pure *cardinalis* and 42 pure *nigrita* from the zone of overlap), and the two species remain quite distinct (Mayr, 1932). There is no evidence concerning the fertility of these hybrids.

Two other cases, however, may be interpreted as stabilized hybrid populations between very distinct forms. These are *malaitae* on Malaita and *pulchella* on New Ireland. These two forms have several things in common. Both are here considered members of the *jugularis* group but have ranges which lie close to the boundary of the range of the *cardinalis* group, on islands which might be colonized by either group. Both occupy a rather uncertain position and are in certain respects intermediate between the two groups. This is particularly striking in the case of *malaitae*. Of these two populations, *malaitae* is no more variable than any other form of the *cardinalis* or *jugularis* groups; of *pulchella*, my material, consisting of a single male, is insufficient to make a decision one way or the other. If, however, these two forms do represent hybrid populations, it almost certainly would mean that introgressive hybridization can occur throughout

the *cardinalis* and *jugularis* groups. If this were shown to be the case, there would be, to my mind, no alternative but to combine all these exceedingly diverse forms into one species. Inasmuch as all the forms of the *cardinalis* and *jugularis* groups have strictly allopatric distributions, there is no real evidence against this. Some of the forms are, however, much more different from one another than are the sympatric *obscura* and *eques* and no less different than is *cruentata* from *adolphinae*, *erythromelas*, and *pulchella*, which occur within its range without interbreeding.

As has been mentioned above, there are several species such as *blasii*, *vulnerata*, *pulchella*, *malaitae*, and perhaps *jugularis*, whose position and relationships seem uncertain. Obviously a new line of attack is indicated. In this connection, Dr. Mayr informs me that each of the New Guinea species of *Myzomela* with which he is familiar has a distinctive song. Undoubtedly, in some of these, a comparison of the song of the doubtful form with those of possible relatives might help to clear up the relationship. I cannot help thinking, however, that in other cases of doubtful relationship, as well as where there is a question as to the specific distinctness of a form, only a genetic analysis of the forms involved, including tests to determine the presence and nature of reproductive isolating mechanisms will resolve these problems with certainty. Unfortunately, in such birds, this is apt to prove very difficult.

CHARACTER ANALYSIS

While the tracing out of the phylogeny and general evolutionary patterns are probably the most interesting results to be gained from a study of evolution in the genus *Myzomela*, much can also be gained from an elucidation of the character variation, that is, to see which characters vary and how. Two characters have been chosen for general analysis, the degree of sexual dimorphism, including secondary masculinization of the female plumage; and the degree of melanization of the male plumage. In addition, a special analysis is made of the geographical distribution of various male color characters in the *cardinalis* and *jugularis* groups.

Sexual Dimorphism.—In Section I, sexual dimorphism is absent, almost certainly primarily. It was apparently only developed in the evolution to Sections II and III, perhaps independently in each section. In *rosenbergii*, it is well-developed, but there is probably in addition some secondary masculinization of the females, though this is far from complete. It is impossible to say for sure, since *rosenbergii* has no close relatives. In Section III, a characteristic female plumage

type is always present except where secondarily masculinized. With one exception, the male plumage is always quite different from this. In *nigrita steini* of Waigeu, however, sexual dimorphism is poorly developed and the male has a plumage rather similar to that of *obscura* or the typical feminine plumage of Section III. Whether this condition is primary or secondary seems impossible to say. In all the other races of *nigrita*, the males are of a distinctive black. Females from the Louisiade and D'Entrecasteaux archipelagos, Woodlark, Japen, Mios Num, southern and western New Guinea, have a typical feminine plumage. Females from San Cristobal, Long, and the Bismarck Archipelago have a completely masculinized plumage. This is apparently dependent upon one gene difference, since in eastern New Guinea, both masculinized and unmasculinized females occur together, without any intermediates. Masculinization has here, then, developed by a single step, unlike its gradual evolution in other groups. (See Figure 2 for the geographical distribution of masculinization in *nigrita*.)

In the *cardinalis* group, the female plumage is unmasculinized except in *erythromelas*, *vulnerata*, and the northern races of *cardinalis*. In *erythromelas* it is only partially masculinized. In *cardinalis*, the female plumage of the races *lifuensis*, *cardinalis*, *tenuis*, *nigriventris*, and probably *tucopiae* is practically unmasculinized, that of *santaecrucis*, *sanfordi*, *pulcherrima*, *dichromata*, and *chermesina* shows varying degrees of intermediacy in that order, while in *rubrata*, *major*, *kurodai*, *kobayashi*, and *saffordi*, the female plumage is almost completely masculinized. Masculinization has apparently been initiated, therefore, three times, and gone to completion twice. From a geographical point of view, fully masculinized females are found on Timor, Kusaie, Truk, Yap, and the Marianas; intermediates on New Britain, Torres Islands, Santa Cruz Islands, Rennell, San Cristobal, Ponape, and Rotuma; unmasculinized females elsewhere. In the species *cardinalis* there is seen to be a cline, masculinization increasing from south to north.

In *cruentata*, the New Guinea females have only slightly masculinized plumage, but proceeding through New Britain to New Ireland, New Hanover, and the Tabar Islands, the female plumage becomes considerably more masculinized. In the *jugularis* group, the female plumage is always considerably masculinized but is virtually completely so only in *eichhorni atrata* of Vella Lavella and Bagga, and in *jugularis* from the Fiji Islands. Elsewhere it is incomplete in varying degrees. The two cases of complete masculinization were certainly acquired independently.

It is interesting to note that secondary loss of sexual dimorphism always occurs in peripheral insular areas rather than on large central land masses such as New Guinea or Australia. The reason for this is not clear but may be associated with the relative lack of predation on the smaller, more oceanic islands. Decrease in the selective value of sexual dimorphism for species recognition seems ruled out, since in the genus *Myzomela* loss of sexual dimorphism almost always involves masculinization of the inconspicuous female plumage rather than feminization of the distinctive and relatively conspicuous male plumage.

Melanization.—Like masculinization of the female plumage, melanization of the male plumage has occurred, in different degrees, a number of times independently in *Myzomela*, though usually not going to completion. Melanization may occur either by a general darkening of gray or brown plumage, or by extension of black areas, thus paralleling the two modes by which reddening is attained.

Melanization does not occur in Section I. In *rosenbergii* it is rather extensive but is confined to the anterior and posterior parts of the body, whereas the middle is red. In *nigrita* it is virtually complete except in *n. steini*, where it is poorly developed or reduced.

In the *cardinalis* group, melanization has been definitely initiated at least three times, being considerable in *erythrocephala dammermani*, *erythromelas*, and *cardinalis*, whereas several of the other races of *erythrocephala* and *dibapha* show earlier stages in the process. Melanization is also marked in *vulnerata*, but this form may have had a common origin with *erythrocephala dammermani*. In the case of *cardinalis*, melanization is clearly due to an extension of black areas, in *e. dammermani* to a general darkening, but in the other cases the mechanism is less clear. Melanized males are thus found in New Britain, Sumba, Timor, and Polynesia.

In the *jugularis* group, melanization is greatest in *malaitae*. The three races of *eichhorni* show an interesting evolutionary series, *e. eichhorni* being only slightly melanized, *e. ganongae* more so, and *e. atrata* considerably, the process being a gradual darkening. In none of the other forms is there much melanization.

M. cruentata shows no special melanization, reddening having occurred instead. Few of the members of Section III, however, are quite as unmelanized as are those of Section I.

Specific color characters.—Because specific color characters in males are so important in distinguishing the various species and super-specific aggregations within the genus, they will receive special treatment. Emphasis will be put upon distinct red patches on various

parts of the body, since these are by far the most important in indicating relationships. A detailed analysis will only be made in the *cardinalis* and *jugularis* groups, where they are widespread and have an interesting geographical distribution, but a few remarks will be made about their occurrence elsewhere.

In Section I, bright red patches are confined to the throat in *eques* and are absent in other forms. In *rosenbergii* (Section II) the entire middle part of the body is red, but the head and adjacent parts are black, this being in contrast to the usual "cephalization" of red found in Section III. In *nigrita* red is absent except in *n. forbesi*, which has a small crown patch. In *cruentata* the entire plumage is red, but, at least in *c. cruentata*, this is somewhat concentrated on the head, breast, belly, rump, and back.

In the *cardinalis* and *jugularis* groups, there are several specific areas where the presence or absence of red is of high taxonomic value, usually being constant among closely related forms. Some of these are, in addition, apparently centers of pigment dispersal. These areas will be treated in turn.

Throat.—This is always red except in the two closely related species, *lafargei* and *melanocephala*, in which it is black. The distribution of the red throat character is therefore the entire range of the two groups except for Buka, Bougainville, Fauro, Choiseul, Ysabel, Florida, and Guadalcanal, all in the Solomons. A red throat may act as a center for the spread of red pigment on the ventral side, in some cases reaching even the lower abdomen. The extent of this spread is, however, very erratic, often differing considerably among closely related subspecies, and is therefore not a very important taxonomic character. Red apparently cannot appear on the breast or belly unless it has been developed on the throat first.

Upper parts of the head.—These are divisible into two distinct regions, the forehead and the nape, which may vary together, as a genetic unit, or independently of one another. The cheeks are always of the same color as the forehead. Both forehead and nape are red in *erythromelas*, *adolphinae*, *erythrocephala*, *dibapha*, and all the races of *cardinalis* except *chermesina*. The geographical range is therefore New Britain, New Guinea, Moluccas, Celebes, Wetar, Timorlaut, Babar, Sumba, Aru Islands, northern and eastern Australia, southern Melanesia, Samoa, San Cristobal, Rennell, and the Carolines and Marianas islands. A red nape only is found in *vulnerata*, *lafargei*, and *jugularis*, whereas some individual males of *eichhorni atrata* have traces of it. This probably represents at least three independent occurrences. Its range is therefore Timor, Buka, Bougainville,

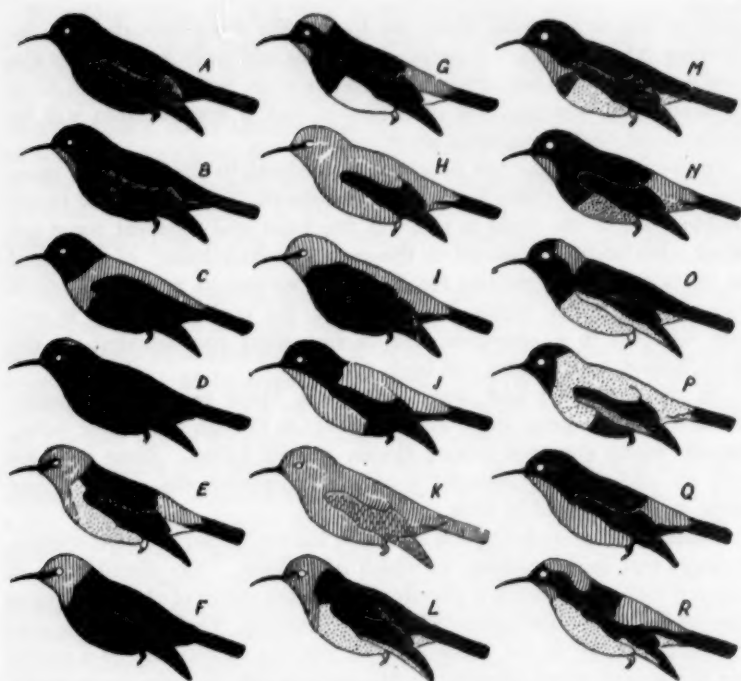


FIGURE 5. Color patterns in *Myzomela* (black, solid; white, blank; red, vertical lines; yellow, stippled; gray or brown, closely hatched); A. *obscura fumata*, B. *eques*, C. *rosenbergii*, D. *nigrita forbesi*, E. *erythrocephala*, F. *erythromelas*, G. *vulnerata*, H. *dibapha wakaloensis*, I. *cardinalis lifuensis*, K. *c. cruentata*, L. *pulchella*, M. *sclateri*, N. *eichhorni atrata*, O. *lafargei*, P. *melanocephala*, Q. *malaitae*, R. *jugularis*.

Choiseul, Fauro, Ysabel, Fijis, and to a slight extent on Vella Lavella and Bagga. A red forehead only is found in *pulchella* of New Ireland. Red is absent from both forehead and nape in *sclateri*, *melanocephala*, *malaitae*, *cardinalis chermesina*, and most individuals of *eichhorni*. In *chermesina* this is certainly secondary, in the others possibly primary. Its range is therefore Karkar, Long, Rook, small islands off the west coast of New Britain, Vella Lavella, Bagga, Ganonga, Kulambangra, Gizo, New Georgia, Vanganu, Rendova, Tetipari, Florida, Guadalcanal, Malaita, and Rotuma.

Rump.—The rump is another center of red pigment dispersal. For red to appear on the back, it must first appear on the rump. A red rump appears in all the forms under consideration except *erythromelas*, *sclateri*, *pulchella*, *melanocephala*, and *lafargei*. In

erythromelas it is certainly secondary, in the others probably primary. Its distribution is therefore the entire range except Karkar, Long, Rook, New Britain and neighboring islets, New Ireland, Buka, Bougainville, Fauro, Choiseul, Ysabel, Florida, and Guadalcanal.

Back.—Unlike the situation in regard to the breast and belly, extension of red from the rump onto the back apparently occurs by a single step. If the back is red at all, it is all red. The distribution

TABLE 1
CHARACTER ANALYSIS OF THE *cardinalis* AND *jugularis* GROUPS

Presence or absence of red on various body parts in males					
Species or subspecies	throat	forehead	nape	back	rump
<i>cardinalis</i> group					
<i>cardinalis</i> subgroup					
<i>cardinalis chermesina</i>	+	—	—	+	+
<i>cardinalis</i> (other races)	+	+	+	+	+
<i>dibapha</i>	+	+	+	+	+
<i>erythrocephala</i> subgroup					
<i>erythrocephala</i>	+	+	+	—	+
<i>adolphinae</i>	+	+	+	—	+
<i>erythromelas</i>	+	+	+	—	—
<i>vulnerata</i>	+	—	—	—	—
<i>jugularis</i> group					
<i>pulchella</i>	+	+	—	—	—
<i>sclateri</i>	+	—	—	—	—
<i>lafargei</i>	—	—	+	—	—
<i>melanocephala</i>	—	—	—	—	—
<i>eichhorni</i>	+	—	—*	—	—
<i>malaitae</i>	+	—	—	—	+
<i>jugularis</i>	+	—	+	—	+

* Some individual males of *e. atrata* have traces of red on the nape.

of red backs, also unlike that of red breasts and bellies, is very constant and not at all erratic, being restricted to, and highly characteristic of, *dibapha* and *cardinalis*. It is, therefore, an important taxonomic character, its distribution being Celebes, the Moluccas, Babar, Timor-laut, eastern Australia, southern Melanesia, Samoa, Rotuma, San Cristobal, Rennell, and the Carolines and Marianas islands.

For a summary of the distribution of red in the *cardinalis* and *jugularis* groups, see Table 1; see also Figures 3, 4, and 5.

I am greatly indebted to Dr. Ernst Mayr for making available to me the material in the Whitney Rothschild Collections of the American

Museum of Natural History, as well as for many helpful suggestions during the study of the material and the preparation of the manuscript.

SUMMARY

The genus *Myzomela*, sensu stricto, may be divided into three sections, based upon female plumage and, to a certain extent, on color patterns in males.

Six species groups are recognized, only one of which includes more than one superspecies. These are based on color pattern in males.

Twenty-one species are tentatively recognized, many of which undoubtedly lie only on the border of specific distinctness.

New Guinea and the nearby islands have been the center of distribution for the genus, though some groups have spread far from the center. The number of species in a given area falls off rapidly, however, as one proceeds away from New Guinea in any direction.

In the ancestral *Myzomela*, both male and female were almost certainly of a similar dull coloration, but in most groups, by acquisition of striking color patterns by the males, a striking sexual difference has developed. Furthermore, the female plumage has been repeatedly masculinized, none of the sexually dimorphic superspecies being wholly free of the effects of this change. This masculinization may be gradual or may arise by one step.

Myzomela is essentially an island genus, being able to colonize new regions across wide stretches of open ocean. The sea has also usually been the primary isolating mechanism, permitting divergence of the isolated populations.

Color patterns in males, particularly the distribution of bright red areas, are of considerable taxonomic importance, especially in the more advanced groups. Two areas, the throat and the rump, may act as centers dispersal of red pigment to other body areas, from the throat to the breast and belly, and from the rump to the back. A completely red or black plumage may arise either by extension of the heavily pigmented areas, or by a general increase in pigmentation.

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APPENDIX
CHECKLIST OF THE SPECIES AND SUBSPECIES OF
MYZOMELA (SENSU STRICTO)

SECTION I

M. eques-obscura group

- M. blasii* Salvadori (Moluccas: Seran)
- M. albigula albigula* Hartert (Lousiades: Rossel)
- M. albigula pallidior* Hartert (west-central Lousiades)
- M. obscura harterti* Matthews (Australia: Cape York peninsula)
- M. obscura obscura* Gould (Australia: Northern Territory)
- M. obscura aruensis* Kinnear (Aru Islands)
- M. obscura fumata* Mueller (southern New Guinea, Misol)
- M. obscura simplex* Gray (Moluccas: Batjan)
- M. obscura rubroincta* Salvadori (Moluccas: Obi)
- M. obscura mortyana* Hartert (Moluccas: Morotai)
- M. obscura rubrobrunnea* Meyer (Geelvink Bay: Biak)
- M. eques eques* Lesson (Waigeu, Salawati, Misol, New Guinea: Vogelkop, Onin Peninsula)
- M. eques nymani* Rothschild and Hartert (southern and eastern New Guinea)
- M. eques primitiva* Stresemann and Paludan (north-central New Guinea)
- M. cineracea rooki* Hartert (Bismarcks: Rook)
- M. cineracea cineracea* Sclater (New Britain)

SECTION II

M. rosenbergii group

- M. rosenbergii rosenbergii* Schlegel (High mountains of New Guinea)
- M. rosenbergii longirostris* Mayr and Rand (D'Entrecasteaux Islands: Good-enough)

SECTION III

M. nigrila group

- M. nigrila steini* Stresemann and Paludan (Waigeu)
- M. nigrila meyeri* Salvadori (Japen, New Guinea except south-central portion)
- M. nigrila pluto* Salvadori (Geelvink Bay: Mios Num)
- M. nigrila nigrila* Gray (south-central New Guinea)
- M. nigrila forbesi* Ramsay (D'Entrecasteaux Islands: Normanby, Goodenough, Dobu)
- M. nigrila lousiadensis* Hartert (Woodlark, Lousiades)
- M. nigrila tristrani* Ramsay (Solomons: San Cristobal, Ugi, Santa Anna)
- M. nigrila pammelaena* Sclater (Bismarcks: Long, Admiralty Islands)
- M. nigrila ernstmayri* Meise (Bismarcks: Ninigo Islands)
- M. nigrila ramsayi* Finsch (Bismarcks: New Hanover, northern New Ireland)
- M. nigrila hades* Meise (Bismarcks: St. Matthias)

M. cardinalis group

M. erythrocephala subgroup

- M. vulnerata* Mueller (Lesser Sundas: Timor)
- M. erythrocephala kuehni* Hartert (Lesser Sundas: Wetar)
- M. erythrocephala dammermani* Siebers (Lesser Sundas: Sumba)
- M. erythrocephala derbyi* Matthews (coast of northwestern Australia)
- M. erythrocephala erythrocephala* Gould (Australia: coast of the Northern Territory, Cape York; New Guinea: region of Hall Sound)

- M. erythrocephala infusata* Forbes (coast of southern New Guinea)
M. adolphinae Salvadori (mountains of New Guinea)
M. erythromelas Salvadori (New Britain)

M. cardinalis subgroup

- M. dibapha eva* Meise (islands south of Celebes: Jampea, Selayar)
M. dibapha juga Riley (south Celebes)
M. dibapha chloroptera Walden (north Celebes)
M. dibapha batjanensis Hartert (Moluccas: Batjan)
M. dibapha wakoloensis Forbes (Moluccas: Buru)
M. dibapha elisabethae van Oort (Moluccas: Seran)
M. dibapha boiei Mueller (Moluccas: Banda)
M. dibapha annabellae Sclater (Timorlaut, Babber Islands)
M. dibapha stephensi Matthews (north-central Queensland)
M. dibapha dibapha Latham (New South Wales, southern Queensland)
M. dibapha caledonica Forbes (New Caledonia)
M. cardinalis lifuensis Layard (Loyalty Islands)
M. cardinalis cardinalis Gmelin (southern New Hebrides)
M. cardinalis tenuis Mayr (Efate and northern New Hebrides, Banks Islands)
M. cardinalis tucopiae Mayr (New Hebrides: Tucopia)
M. cardinalis nigriventris Peale (Samoa)
M. cardinalis sanctaecrucis Sarasin (Santa Cruz and Torres Islands)
M. cardinalis sanfordi Mayr (Solomons: Rennell)
M. cardinalis pulcherrima Ramsay (Solomons: San Cristobal, Ugi)
M. cardinalis chermesina Gray (Rotuma)
M. cardinalis rubrata Lesson (Carolines: Kusiae)
M. cardinalis dichromata Wetmore (Carolines: Ponape)
M. cardinalis major Bonaparte (Carolines: Truk)
M. cardinalis kurodai Momiyama (Carolines: Yap)
M. cardinalis kobayashi Momiyama (Palau)
M. cardinalis saffordi Wetmore (Marianas)

M. cruentata group

- M. cruentata cruentata* Meyer (New Guinea, Japan)
M. cruentata kleinschmidti Sharpe (Bismarcks: New Britain)
M. cruentata coccinea Ramsay (Bismarcks: Duke of York)
M. cruentata erythrina Ramsay (Bismarcks: New Ireland, New Hanover, Tabar Islands)

M. jugularis group

- M. sclateri* Forbes (Bismarcks: Karkar, Long, Rook, small islands off the west coast of New Britain)
M. pulchella Salvadori (Bismarcks: New Ireland)
M. lafargei Pucheran (Solomons: Buka, Bougainville, Fauro, Choiseul, Yaabel)
M. melanocephala Ramsay (Solomons: Guadalcanal, Florida)
M. eichhorni eichhorni Rothschild and Hartert (Central Solomons: Gizo, Kulambangra, New Georgia, Vangunu, Rendova, Tetipari)
M. eichhorni ganongae Mayr (Central Solomons: Ganonga)
M. eichhorni atrata Hartert (Central Solomons: Vella Lavella, Bagga)
M. malaitae Mayr (Solomons: Malaita)
M. jugularis Peale (Fijis)

Queens College, Flushing, New York, March 15, 1954.

INDIVIDUAL VARIATION IN THE FISH CROW,
CORVUS OSSIFRAGUS

BY JULIAN J. BAUMEL

THE present study deals with quantitative variation in weight and in the integumentary and skeletal systems of *Corvus ossifragus*. The White-necked Raven (*Corvus cryptoleucus*) was similarly treated in a previous paper (Baumel, Condor, 55: 26-32, 1953).

Over a period of years I have had occasion to acquire and prepare a series of skeletons of *C. ossifragus*, most of which were collected in Florida. Weight, several external measurements, and age of each specimen were recorded prior to skeletonizing. The age classes, immature or adult, were determined from plumage characteristics following Emlen (Condor, 38: 99-102, 1936). Those birds which had not completed the first postnuptial molt were considered immature. Approximately half the series consists of immature specimens. Since the series is divisible into age classes, it was necessary to learn to what extent, if any, the classes differed in size and weight.

Throughout the paper the following abbreviations are used: N = number of specimens; R = observed range; M = mean; σ = standard deviation; V = coefficient of variability (per cent); CD = coefficient of divergence (per cent). Confidence limits equivalent to t -values of 3.00 are used as criteria of statistical significance.

Weight.—Emlen (*op. cit.*) states that first-year *Corvus brachyrhynchos* generally weigh 20 to 30 grams more than adults of their respective sexes as winter approaches. The specimens of *ossifragus* were collected throughout the year; thus, no direct comparison with *brachyrhynchos* along these lines can be undertaken. By calculating means and standard deviations for the four groups (adult males, immature males, adult females, and immature females) and applying statistical tests, it was learned that no significant differences between means of the age groups existed for either sex. Because of this, weights of immatures and adults were combined and recast as single distributions (Table 1).

TABLE 1
BODY WEIGHT (GRAMS) OF *Corvus ossifragus*

Sex	N	R	M	σ	V	CD
♂	20	260.4-332.0	299.94 \pm 4.65	20.28 \pm 3.21	6.76 \pm 1.07	10.41
♀	19	194.7-304.2	270.25 \pm 5.43	23.04 \pm 3.74	8.52 \pm 1.38	

From this table it is evident that the mean weight of males exceeds that of females, but the observed ranges overlap. The difference

between the means is significant ($t = 4.3$). The coefficients of variability suggest that females may be more variable than males. A t -test proved this difference was not real. The coefficient of divergence here conveys the information that male Fish Crows average 10.41 per cent heavier than females.

External Measurements (Table 2).—Culmen length was measured with dividers from the fronto-nasal angle to the tip of the bill. Wing

TABLE 2
EXTERNAL MEASUREMENTS (MM.) OF *Corvus ossifragus*

Measurement	Sex	N	R	M	σ	V	CD
Culmen length	♂	25	44.0-54.9	47.96 \pm 0.52	2.53 \pm 0.36	5.28 \pm 0.75	10.35
	♀	20	40.0-47.6	43.24 \pm 0.41	1.81 \pm 0.29	4.18 \pm 0.66	
Tarsus length	♂	25	42.8-49.5	46.40 \pm 0.35	1.72 \pm 0.24	3.71 \pm 0.53	4.16
	♀	20	41.7-46.2	44.51 \pm 0.32	1.41 \pm 0.22	3.17 \pm 0.50	
Middle toe without claw	♂	25	32.3-38.9	35.94 \pm 0.34	1.67 \pm 0.24	4.64 \pm 0.66	5.69
	♀	20	31.7-38.4	33.95 \pm 0.37	1.62 \pm 0.26	4.77 \pm 0.75	
Middle toe with claw	♂	25	42.5-52.1	47.99 \pm 0.62	3.04 \pm 0.43	6.33 \pm 0.90	7.21
	♀	20	41.5-50.2	44.65 \pm 0.53	2.29 \pm 0.36	5.12 \pm 0.81	
Wing length	♂	24	260-300	281.1 \pm 2.15	10.31 \pm 1.49	3.67 \pm 0.53	4.66
	♀	20	253-283	268.3 \pm 2.04	8.87 \pm 1.40	3.31 \pm 0.52	
Tail length	♂	24	147-174	159.7 \pm 1.38	6.60 \pm 0.95	4.14 \pm 0.60	6.40
	♀	20	135-160	149.8 \pm 1.40	6.12 \pm 0.97	4.09 \pm 0.65	

length was taken with the remiges flattened (arc). The other measurements are those in standard use among ornithologists and need no definition.

For the characters, culmen length, tarsus length, and lengths of middle toe with and without claw, the means of immatures and the means of adults very closely approximated one another. Age differences in neither sex were manifest.

In the case of the two remaining external characters, wing length and tail length, considerable differences between the means of adults and immatures were obtained. The means of adults were slightly larger in all instances. Statistical tests were applied, and it was observed that the age differences in wing length approached significance:

$$\begin{array}{ll} \text{Males } t = 1.9 & P < 0.10 \\ \text{Females } t = 1.6 & P < 0.20 \end{array}$$

Age differences between means for tail length are even more statistically valid than with the wing:

$$\begin{array}{ll} \text{Males } t = 3.4 & P < 0.01 \\ \text{Females } t = 2.2 & P < 0.05 \end{array}$$

It is felt that a larger sample might demonstrate all of these to be significant.

Because of the above non-significant differences, all adult and immature external measurement values for each sex were lumped, and this aggregate data provides the basis for the statistics in Table 2.

Mean measurements of males are in all cases significantly larger than those of females (t 's 4.0–7.0); however, there is overlap. Comparison of the coefficients of variability shows neither sex significantly more variable than the other in any external character. Coefficients of variability of the six external measurements were averaged: ♂ $M = 4.63$, ♀ $M = 4.11$. Culmen length presents the most sexual divergence ($CD = 10.35$ per cent). The average sexual divergence (means of 6 CD 's) is 6.41 per cent. Comparison of skeletal data with the data on external measurements shows slightly more sexual dimorphism in size exhibited by the latter.

Skeletal Measurements.—Forty-one measurements of the skeleton were made on each of the 39 specimens unless elements were lacking or broken. Measurement methods for all but the few defined below were described in the previous paper on *Corvus cryptoleucus* (Baumel, *op. cit.*).

Maxillary width.—Greatest width of upper jaw, at level of bases of maxillo-palatine processes.

Interorbital width.—Least width across frontal bones between orbits.

Symphysis length.—Length of mandibular symphysis.

Articular width.—Transverse distance between tips of internal and external process of articular bone of lower jaw.

Sternum length.—Distance from ventral manubrial spine to posterior border of metasternum.

Anterior sternum width.—Transverse distance between lateral margins of sterno-coracoidal processes of sternum.

Epicleidium.—Antero-posterior length of dorsal, expanded end of clavicle.

Coracoid width.—Width of sternal end of coracoid; from internal distal angle to most lateral point on sterno-coracoidal process.

Pre-iliun width.—Least transverse width across pre-acetabular ilia.

Data on the skeleton are to be seen in Table 3. It should be explained that these data are based on samples comprised of both immature and adult specimens. Prior to combining the skeletal measurements of both groups, it was necessary to determine if adults and immatures differed to any appreciable extent. Significant differences were not found.

Table 3 shows that in every instance, except that of *interorbital*

TABLE 3
SKELETAL MEASUREMENTS (MM.) OF *Corvus ossifragus*

Measurement	Sex	N	R	M	<i>s</i>	V	CD
Skull length	♂	20	73.6-81.3	77.90 ± 0.45	2.01 ± 0.32	2.58 ± 0.41	6.67
	♀	19	70.5-76.4	72.87 ± 0.35	1.53 ± 0.25	2.10 ± 0.34	
Cranial length	♂	20	35.7-37.8	36.56 ± 0.14	0.61 ± 0.10	1.66 ± 0.26	3.71
	♀	18	33.7-36.4	35.23 ± 0.18	0.75 ± 0.12	2.12 ± 0.35	
Cranial depth	♂	19	20.6-23.0	21.51 ± 0.15	0.64 ± 0.10	2.98 ± 0.48	0.47
	♀	19	19.7-22.6	21.41 ± 0.16	0.71 ± 0.12	3.33 ± 0.54	
Culmen length	♂	20	39.5-45.7	42.83 ± 0.38	1.72 ± 0.27	4.01 ± 0.63	9.45
	♀	18	36.3-41.0	38.89 ± 0.29	1.21 ± 0.20	3.12 ± 0.52	
Frontonasal width	♂	20	18.3-20.5	19.10 ± 0.12	0.54 ± 0.09	2.81 ± 0.45	4.99
	♀	18	16.4-19.6	18.17 ± 0.18	0.76 ± 0.13	4.16 ± 0.69	
Maxillary width	♂	20	16.8-18.9	17.83 ± 0.13	0.58 ± 0.09	3.26 ± 0.52	7.69
	♀	19	16.0-17.8	16.51 ± 0.12	0.51 ± 0.08	3.07 ± 0.50	
Interorbital width	♂	20	12.2-14.6	13.37 ± 0.16	0.71 ± 0.11	5.32 ± 0.84	*1.12
	♀	17	11.6-16.3	13.52 ± 0.23	0.95 ± 0.16	7.06 ± 1.21	
Postorbital width	♂	20	31.1-33.2	31.97 ± 0.13	0.60 ± 0.10	1.88 ± 0.30	3.44
	♀	19	29.9-31.7	30.89 ± 0.11	0.49 ± 0.08	1.58 ± 0.26	
Ramus length	♂	19	60.3-66.7	63.38 ± 0.40	1.73 ± 0.28	2.73 ± 0.44	7.45
	♀	18	56.8-62.1	58.83 ± 0.36	1.53 ± 0.26	2.60 ± 0.43	
Ramus height	♂	20	6.1- 6.9	6.53 ± 0.05	0.23 ± 0.04	3.55 ± 0.56	3.90
	♀	19	5.8- 6.6	6.28 ± 0.05	0.24 ± 0.04	3.77 ± 0.61	
Symphysis length	♂	19	13.8-16.9	15.31 ± 0.20	0.85 ± 0.14	5.57 ± 0.90	10.66
	♀	18	12.3-15.2	13.76 ± 0.18	0.74 ± 0.12	5.40 ± 0.90	
Articular width	♂	20	9.5-10.9	10.45 ± 0.07	0.33 ± 0.05	3.15 ± 0.50	7.24
	♀	19	9.3-10.2	9.72 ± 0.06	0.26 ± 0.04	2.65 ± 0.43	
Basihyal length	♂	20	11.5-14.6	13.15 ± 0.20	0.88 ± 0.14	6.68 ± 1.06	7.25
	♀	19	10.4-13.8	12.23 ± 0.21	0.91 ± 0.15	7.44 ± 1.21	
Sternum length	♂	20	46.0-49.5	47.68 ± 0.22	0.98 ± 0.16	2.05 ± 0.32	6.21
	♀	19	41.4-47.2	44.81 ± 0.36	1.58 ± 0.26	3.52 ± 0.57	
Keel length	♂	20	42.6-46.8	44.95 ± 0.27	1.21 ± 0.19	2.69 ± 0.43	6.90
	♀	18	38.7-45.0	41.95 ± 0.42	1.76 ± 0.29	4.21 ± 0.70	
Keel depth	♂	20	13.8-16.5	15.15 ± 0.13	0.56 ± 0.09	3.69 ± 0.58	5.49
	♀	19	13.5-15.3	14.34 ± 0.14	0.63 ± 0.10	4.37 ± 0.71	
Anterior sternum width	♂	20	24.9-29.4	27.07 ± 0.25	1.13 ± 0.18	4.17 ± 0.66	4.96
	♀	18	23.6-28.1	25.76 ± 0.29	1.21 ± 0.20	4.71 ± 0.78	
Mid-sternum width	♂	20	21.7-26.0	23.35 ± 0.24	1.06 ± 0.17	4.55 ± 0.72	2.56
	♀	18	21.8-24.3	22.76 ± 0.18	0.76 ± 0.13	3.34 ± 0.56	
Clavicle length	♂	19	36.6-40.1	37.90 ± 0.24	1.04 ± 0.17	2.74 ± 0.45	4.73
	♀	19	34.2-38.1	36.15 ± 0.23	1.00 ± 0.16	2.76 ± 0.45	
Epicleidium	♂	20	9.3-11.0	10.14 ± 0.09	0.40 ± 0.06	3.96 ± 0.63	7.89
	♀	19	8.8- 9.9	9.37 ± 0.06	0.28 ± 0.05	2.96 ± 0.48	
Coracoid width	♂	20	9.9-11.9	11.03 ± 0.11	0.50 ± 0.08	4.54 ± 0.72	4.07
	♀	19	9.7-11.7	10.59 ± 0.11	0.46 ± 0.07	4.33 ± 0.70	
Coracoid length	♂	20	37.9-40.8	39.36 ± 0.15	0.68 ± 0.11	1.73 ± 0.27	7.90
	♀	19	35.2-40.2	37.33 ± 0.22	0.97 ± 0.16	2.60 ± 0.42	
Scapula length	♂	20	42.2-47.5	45.30 ± 0.31	1.39 ± 0.22	3.08 ± 0.49	6.26
	♀	19	39.8-44.9	42.55 ± 0.24	1.04 ± 0.17	2.44 ± 0.40	
Humerus length	♂	20	55.7-60.0	58.05 ± 0.26	1.15 ± 0.18	1.98 ± 0.31	4.74
	♀	19	52.5-59.0	55.36 ± 0.35	1.52 ± 0.25	2.74 ± 0.44	
Ulna length	♂	20	70.3-79.2	74.45 ± 0.44	1.98 ± 0.31	2.65 ± 0.42	4.59
	♀	19	67.3-76.2	71.11 ± 0.46	2.02 ± 0.33	2.84 ± 0.46	
Radius length	♂	20	63.6-72.0	67.65 ± 0.40	1.79 ± 0.28	2.65 ± 0.42	4.15
	♀	19	61.2-69.8	64.90 ± 0.47	2.04 ± 0.33	3.14 ± 0.51	
Metacarpus II	♂	20	37.4-42.0	39.82 ± 0.26	1.16 ± 0.18	2.91 ± 0.46	4.31
	♀	19	35.8-39.6	38.14 ± 0.22	0.96 ± 0.16	2.52 ± 0.41	
Metacarpus III	♂	20	40.9-45.6	43.25 ± 0.26	1.15 ± 0.18	2.66 ± 0.42	4.88
	♀	19	39.2-42.6	41.19 ± 0.21	0.93 ± 0.15	2.25 ± 0.37	

* Mean for female greater than that for male.

TABLE 3—Continued

Measurement	Sex	N	R	M	s	V	CD
<i>Index, Phalanx 1</i>	♂	20	19.4-21.9	20.81 ± 0.12	0.55 ± 0.09	2.66 ± 0.42	6.81
	♀	19	17.8-20.8	19.44 ± 0.16	0.70 ± 0.11	3.62 ± 0.59	
<i>Index, Phalanx 2</i>	♂	20	11.7-13.1	12.54 ± 0.11	0.47 ± 0.07	3.76 ± 0.59	4.48
	♀	19	11.2-12.6	11.99 ± 0.10	0.43 ± 0.07	3.56 ± 0.58	
<i>Synsacrum length</i>	♂	18	36.1-40.2	38.20 ± 0.25	1.05 ± 0.18	2.76 ± 0.46	4.17
	♀	18	33.7-38.7	36.64 ± 0.27	1.14 ± 0.19	3.11 ± 0.52	
<i>Pre-iliac width</i>	♂	20	14.8-17.9	16.60 ± 0.16	0.70 ± 0.11	4.22 ± 0.67	4.37
	♀	19	15.3-17.1	15.89 ± 0.11	0.47 ± 0.08	2.94 ± 0.48	
<i>Mid-synsacrum width</i>	♂	20	27.3-30.1	28.35 ± 0.16	0.70 ± 0.11	2.46 ± 0.39	3.48
	♀	19	26.0-28.7	27.38 ± 0.15	0.67 ± 0.11	2.46 ± 0.40	
<i>Post-iliac width</i>	♂	19	24.9-28.3	27.01 ± 0.21	0.90 ± 0.15	3.34 ± 0.54	2.06
	♀	19	25.2-28.5	26.46 ± 0.21	0.89 ± 0.15	3.38 ± 0.55	
<i>Pelvic width</i>	♂	19	20.8-23.8	21.78 ± 0.16	0.71 ± 0.12	3.26 ± 0.53	4.22
	♀	19	19.2-22.7	20.88 ± 0.21	0.91 ± 0.15	4.35 ± 0.71	
<i>Femur length</i>	♂	19	42.3-46.7	44.54 ± 0.26	1.11 ± 0.18	2.50 ± 0.41	4.50
	♀	19	39.3-45.7	42.58 ± 0.27	1.18 ± 0.19	2.77 ± 0.45	
<i>Tibia length</i>	♂	20	70.6-79.4	75.50 ± 0.43	1.91 ± 0.30	2.53 ± 0.40	4.51
	♀	18	67.7-77.5	72.17 ± 0.50	2.10 ± 0.35	2.91 ± 0.49	
<i>Tarsus length</i>	♂	20	43.8-49.7	47.65 ± 0.33	1.49 ± 0.24	3.12 ± 0.49	4.24
	♀	18	42.4-48.2	45.67 ± 0.30	1.27 ± 0.21	2.79 ± 0.46	
<i>Pygostyle length</i>	♂	18	16.4-19.2	17.53 ± 0.19	0.82 ± 0.14	4.66 ± 0.78	6.30
	♀	19	14.7-18.4	16.46 ± 0.19	0.83 ± 0.14	5.06 ± 0.82	
<i>Hallux, Phalanx 1</i>	♂	20	17.4-20.2	18.90 ± 0.16	0.71 ± 0.11	3.74 ± 0.59	7.01
	♀	19	16.3-18.4	17.62 ± 0.11	0.47 ± 0.08	2.68 ± 0.44	
<i>Hallux, Ungual Phalanx</i>	♂	20	13.9-15.9	15.03 ± 0.13	0.57 ± 0.09	3.78 ± 0.60	6.95
	♀	19	13.2-14.9	14.02 ± 0.09	0.41 ± 0.07	2.90 ± 0.45	

width, the means of males are greater than those of females, but the observed ranges overlap. Only four characters [*cranial depth* ($t = 0.46$), *interorbital width* ($t = 0.55$), *mid-sternum width* ($t = 1.95$), and *post-iliac width* ($t = 1.89$)], failed to demonstrate a significant difference between the means of males and those of females.

Coefficients of divergence, expressing the percentage of size dimorphism between the sexes, range from 0.47 to 10.66, and average 5.39 per cent (*interorbital width* excluded). The modal class of coefficients of divergence falls between 4 and 5 per cent; thus, it can be stated that the skeletons of male *ossifragus* are about 5 per cent larger than those of females.

Coefficients of variability range from 1.58 to 7.44 per cent for males and from 1.66 to 6.68 per cent for females. In no instance was either sex significantly more variable than the other. Means and modes were calculated on the coefficients of variability for the entire group of 41 measurements:

	Mean	Mode
♂	3.29	2.66
♀	3.41	2.39

An idea of the degree of variation in size of the "composite" skeleton of *ossifragus* may be gained from the summation above.

Discussion.—Wing length and tail length are the only characters considered which demonstrate any appreciable mean size differences between immatures and adults. Inasmuch as these are plumage characters, such differences are not unexpected in view of the other qualitative or morphological differences in plumage exhibited between birds of the year and adults.

The other external measurements are in reality measurements of the skeleton. Significant differences between the age groups are lacking for these as well as for the skeletal measurements *per se*, which indicates that definitive skeletal size in *ossifragus* is probably attained soon after fledging.

Corvus ossifragus displays essentially the same magnitude of variation as does *C. cryptoleucus*; however, greater average size differences between the sexes are found for *ossifragus* than for *cryptoleucus*. The following figures will illustrate this:

Average of CD's (per cent)	<i>C. ossifragus</i>	<i>C. cryptoleucus</i>
Weight	10.41	8.23
External measurements	6.41	3.07
Skeletal measurements	5.39	3.18

Department of Anatomy, School of Medicine, Creighton University,
Omaha 2, Nebraska, August 4, 1955.

PROCEEDINGS OF THE SEVENTY-FOURTH STATED MEETING OF THE AMERICAN ORNITHOLOGISTS' UNION

BY HAROLD MAYFIELD, SECRETARY

THE Seventy-fourth Stated Meeting of the American Ornithologists' Union was held from September 4 to 9, 1956, at the Denver Museum of Natural History and the University of Colorado. Business sessions were held on September 4, papers sessions on September 5, 6, and 7, and field trips on September 8 and 9.

BUSINESS SESSIONS

On September 4, the Council met throughout most of the day, the Fellows met in the late afternoon, and the Fellows and Elective Members met together in the evening.

1957 Meeting.—The Seventy-fifth stated meeting will be held at Cape May, New Jersey, in the week of September 9, 1957. Host organizations are the Philadelphia Academy of Natural Sciences and the Delaware Valley Ornithological Club. M. Albert Linton and Philip A. Livingston are co-chairmen of the Local Committee on Arrangements.

1958 Meeting.—The Council favored holding the 1958 meeting in New York City in mid-October of that year. It was felt appropriate that this seventy-fifth anniversary meeting be held in the city of the founding and of the fiftieth anniversary meeting. Final decision on the 1958 meeting will be made at the 1957 meeting.

The Council also considered an attractive invitation from Regina, Saskatchewan, which will be considered again at a later date.

Awards.—The Brewster Memorial Award, by action of the Council, was presented to George H. Lowery, Jr., Louisiana State University, for his highly original and illuminating contributions to our knowledge of the nocturnal migration of birds, and in particular, his chief paper, "A Quantitative Study of the Nocturnal Migration of Birds," published in 1951 by the Museum of Natural History of the University of Kansas.

Marcia B. Tucker Awards in Ornithology were granted, by vote of the officers, to Judith Stenger, University of Toronto, and Russell Mumford, University of Michigan. These cash awards make it possible for promising young ornithologists to attend the annual meeting at a distance from their homes.

William H. Behle, Chairman of the Committee on Student Membership Awards, reported that 'The Auk' is being sent free to 24 students, whose names were published in 'The Auk' for April, 1956.

The Council voted to inscribe the names of two deceased Fellows as Patrons: James Lee Peters, in recognition of a gift in his memory by Mrs. Herbert C. Carnes; and T. S. Palmer, in recognition of his many generous gifts to the A.O.U. over a period of years.

Amendments to the By-Laws.—The Fellows gave final approval to an amendment to the By-Laws providing that one vice-president be elected each year for a two-year term, the first year to be served as Second Vice-President and the second year as First Vice-President. The full amendment is published in the Proceedings in the January, 1956, 'Auk,' (pp. 106-107).

No new amendments were proposed.

Reports of Officers.—The Secretary reported that 3072 copies of 'The Auk' were being mailed. The Treasurer's records showed members by classes, as of September 11, as follows: Fellows, 76; Fellows Emeriti, 2; Honorary Fellows, 20; Corresponding Fellows, 63; Elective Members, 198; Members, 2281; Student Members, 24. Other mailings go to institutional subscribers and to organizations with whom we are exchanging journals. Between October 1, 1955, and September 1, 1956, we enrolled 162 new members.

The report of the Treasurer, Charles G. Sibley, is published in full in this issue of 'The Auk.' The Auditing Committee (A. W. Schorger, Chairman; Hoyes Lloyd, William H. Behle) examined the books of the Treasurer and found them in good order. The Council approved the Treasurer's request to end the fiscal year on July 31 in order to allow a year-end report at annual meetings whether held in September or October.

In the absence of Stephen S. Gregory, Chairman, A. W. Schorger reported for the Investing Trustees. The appraised value of the endowment holdings as of August 15, 1956, was \$116,151, representing an increase in value of \$8,147 and additions to the fund of \$2,688 since September 30, 1955. The estimated income from the fund for the twelve months ending September 30, 1956, was \$3,979.

The Editor, Robert W. Storer, reported that 'The Auk' for the last year, beginning with the October, 1955, issue, contained 622 pages and 19 plates, not counting the 76 pages of Membership List distributed separately. Special thanks were expressed to Col. L. R. Wolfe for indexing the current volume, and to Frank McKinney for his work on the Recent Literature section.

The Council voted a resolution of thanks to C. K. Nichols for his diligent work on the Ten-year Index. The basic manuscript is completed but there is checking to be done, and the Committee on Publications is to study the various means of publication.

Handbook of North American Birds.—R. S. Palmer, Editor of the proposed Handbook, reported that substantial progress has been made on range maps and text. It is hoped that the manuscript of volume 1, loons through ducks, can be completed by December 1, 1957. There is a need for authors and financial assistance on this most important work in preparation.

Reports of Committees.—A. W. Schorger, Chairman of the Committee on Biography, reported that two memorials and three obituaries were published during the year ending with the July, 1956, issue of 'The Auk.' During the year the Committee received notices of the deaths of 17 Members and two Corresponding Fellows:

Ivers Shepard Adams, Member, June 10, 1955.
Stanley Crittenden Ball, Member, August 9, 1956.
Esaie John Besson, Member, August 2, 1956.
Clarence Duvall Brown, Member, June 29, 1956.
Morris Miller Green, Life Member, May 26, 1955.
George Leib Harrison, Life Member, November 21, 1955.
Clara Louise Hershey, Member, September 16, 1955.
John Townsend Sharpless Hunn, Honorary Life Member, October 2, 1954.
Renwick Reeve Kerr, Member, March 15, 1955.
John Francis McClure, Member, April 2, 1955.
Robert Poncy, Corresponding Fellow, December 7, 1955.
Charles James Rhoads, Life Member, January 2, 1956.
Mrs. Winifred Sprague Sabine, Member, July 11, 1956.
H. T. L. Schaanning, Corresponding Fellow, March 5, 1956.
Jule R. Schmidt, Member, October 23, 1955.
Anna Creighton Scott, Member, October 25, 1955.
Carll Tucker, Life Member, July 29, 1956.
Yens M. Welling, Life Member, December 8, 1955.
Robert Weston, Member, June 4, 1955.

Mrs. Herbert E. Carnes, Chairman of the Endowment Committee, reported total additions to the endowment fund since October 1, 1955, of \$3,245.71. This amount included a donation of \$1000 from Mrs. Carnes, given in memory of the late James Lee Peters, with the request that he be listed hereafter as Patron.

Alexander Wetmore, Chairman of the Committee on Classification and Nomenclature, reported that the Fifth Edition of the Check-list is partially in type, and there is a reasonable expectation that it will be published by mid-year in 1957. The volume will contain about 750 pages and will be printed in 3000 copies. The price and other details will be published in 'The Auk' as soon as the information is available.

In the absence of Ira Gabrielson, Chairman, Hoyes Lloyd reported for the Committee on Bird Protection. The full report appears in this issue of 'The Auk.'

Frank A. Pitelka, Chairman of the Committee on Research, reported that the Committee has taken some preliminary steps toward a possible study of the spread of the Cattle Egret in this country and has conducted some correspondence on unpublished theses. This Committee expects to be of help to the Editor of the Handbook of North American Birds. Albert Wolfson, former Chairman, reported that the first printing of 1000 copies of "Recent Studies in Avian Biology" has been exhausted and a second printing of the same number has been produced. Advance sales by the A.O.U. exceeded the guarantee of 500 to the University of Illinois Press. At the present rate of sale the second printing will last about two years. Sales from the second printing will bring to the A.O.U. a royalty payment amounting to 15 per cent of the wholesale price.

Election of Officers.—At the meeting of Fellows and Elective Members, Ludlow Griscom was elected President. However, soon after the meeting he informed the Council that it would be necessary for him to resign because of ill health. Therefore, Ernst Mayr advanced from First Vice-President to President; George H. Lowery, Jr., advanced from Second Vice-President to First Vice-President; and, by mail vote of the Council, Austin L. Rand became Second Vice-President. The Treasurer, Charles G. Sibley, and the Secretary, Harold F. Mayfield, were re-elected. Four new members of the Council were elected.

The Council re-elected the Editor of 'The Auk,' Robert W. Storer, and re-elected the three investing trustees. The complete list of officers is shown on page 89.

ELECTION TO SPECIAL CLASSES OF MEMBERSHIP

FELLOW

Ralph S. Palmer, Albany, New York.

(There were no vacancies in the class of Honorary Fellow.)

CORRESPONDING FELLOWS

H. N. Kluyver, Arnhem, Netherlands.

William W. A. Phillips, Namunukula, Ceylon.

William H. Thorpe, Cambridge, England.

Charles M. N. White, Lusaka, Northern Rhodesia.

ELECTIVE MEMBERS

David Aird Munro, Ottawa, Canada.

William H. Partridge, Buenos Aires, Argentina.

Frank W. Preston, Butler, Pennsylvania.

PATRONS

T. S. Palmer (deceased).

James Lee Peters (deceased).

ATTENDANCE

Registration at the meeting included 258 people from 34 states, Puerto Rico, Alaska, the District of Columbia, 4 provinces of Canada, and 3 other countries as follows:

ALASKA—*College*: Brina Kessel.

ARGENTINA—*Buenos Aires*: William H. Partridge.

CANADA—*British Columbia*: Mr. and Mrs. Theed Pearse, Miklos D. F. Udvady. *Manitoba*: Frank McKinney. *Ontario*: Mr. and Mrs. A. E. Allin, Mr. and Mrs. Hoyes Lloyd, Mr. and Mrs. L. L. Snyder, Mr. and Mrs. J. Murray Speirs, Judith Stenger. *Saskatchewan*: J. Bernard Collop, Mr. and Mrs. Stuart Houston, George F. Ledingham, Robert W. Nero.

FINLAND—*Helsingfors*: Lars von Haartman.

GERMANY—*Wilhelmshaven*: Lorenz Kramer.

PUERTO RICO—*Mayaguez*: Virgilio Biaggi, Jr.

UNITED STATES—*Arizona*: Mr. and Mrs. Anders H. Anderson, James T. Bialac, Joe Marshall, A. R. Phillips, James R. Werner. *California*: Enid K. Austin, Richard C. Banks, A. Laurence Curl, Mr. and Mrs. John Davis, J. Delacour, William R. Fish, Mr. and Mrs. Earle Greene, Donald V. Hemphill, Hildegard Howard, Mr. and Mrs. Thomas R. Howell, Mrs. Junea W. Kelly, Jean M. Linsdale, Mr. and Mrs. Alden H. Miller, Sidney B. Peyton, Frank A. Pitelka, Jay Schnell, Catherine D. Shaw, Dorothy P. Sheffler, W. J. Sheffler, Kenneth E. Stager, Laidlaw Williams. *Colorado*: Mr. and Mrs. A. M. Bailey, Paul H. Baldwin, L. M. Baylor, Richard G. Beidleman, Venold J. Bivans, Adrey E. Borell, Mrs. Gilbert L. Catlett, John L. Chapin, Mrs. Carl N. Collister, Mrs. A. H. Crow, L. D. Crowley, Laurence H. Field, Mrs. L. B. Field, Richard C. Funk, Joseph G. Hall, Mrs. Eleanor S. Hough, John N. Hough, Catherine A. Hurlbutt, A. S. Hyde, E. R. Kalmbach, Kathryn Kalmbach, Cecil C. Kersting, Owen A. Knorr, Robert R. Lechleitner, Thompson G. Marsh, Dorothy Mierow, Mrs. Noble J. Miller, Richard S. Miller, Johnson A. Neff, Robert J. Niedrach, Mrs. Lillian Noble, Dale W. Rice, Willis C. Royall, Jr., Mrs. Frank Sample, Horace G. Smith, Robina C. Storrie, Donald M. Thatcher, Oakleigh Thorne, II, Helen B. Thurlow, Claude A. Van Epps, Mrs. H. J. Wagner, C. S. Williams. *Connecticut*: Mr. and Mrs. S. Dillon Ripley, Reynolds Thompson. *Delaware*: William Baxter. *District of Columbia*: Herbert Friedmann, Mr. and Mrs. Frederick C. Lincoln, Mr. and Mrs. Alexander Wetmore. *Florida*: Samuel A. Grimes, Louis A. Stimson. *Georgia*: H. L. Stoddard, Sr. *Illinois*: Ormsby Annan, Karl E. Bartel, Richard Brewer, Mr. and Mrs. S. C. Kendeigh, Constance Nice, Margaret M. Nice, L. B. Nice, Karl Plath, A. L. Rand, Dave Seal, Melvin Traylor. *Indiana*: Mr. and Mrs. James B. Cope, Paul A. Davis, Val Nolan, Jr., Susan Smith, Dan Webster, Ronald J. Wolf. *Iowa*: A. Lang Bailly, F. W. Kent, Peter Petersen, Jr., Fred J. Pierce. *Kansas*: Sydney Anderson, John William Hardy, Mr. and Mrs. Robert M. Mengel, Philip W. Ogilvie, Harrison B. Tordoff, Phillip M. Youngman. *Kentucky*: Nixon A. Wilson. *Louisiana*: William Belknap, Mrs. Ethel D. Jones, Douglas A. Lancaster, Mr. and Mrs. George H. Lowery, Jr., Brooke Meanley, Marcella Newman, Robert J. Newman, Stephen M. Russell, Ava R. Tabor, Edwin Willis. *Maine*: Mr. and Mrs. O. S. Pettingill, Jr.

Massachusetts: Ernst Mayr., Raymond A. Paynter, Jr., Dorothy E. Snyder, Herman R. Sweet. *Michigan*: Laurence C. Binford, Mr. and Mrs. Ralph M. Branch, Mrs. Edith K. Frey, Philip S. Humphrey, Elmer J. Kuhn, Russell E. Mumford, Richard B. Root, Mrs. Mary Spear Ross, Robert W. Storer, Mr. and Mrs. Josselyn

Van Tyne, George J. Wallace, Dale A. Zimmerman, Richard L. Zusi. *Minnesota*: Mr. and Mrs. Whitney Eastman, Robert Galati, Mr. and Mrs. Byron E. Harrell, Mr. and Mrs. Francis L. Jaques, William R. Luwe, Dwain W. Warner. *Montana*: Robert H. Gensch. *Nebraska*: Henry E. Baumgarten, William Ferguson, Doris Gates, Mrs. Earl Lionberger, William F. Rapp, Jr. *New Jersey*: Betty Carnes, Mr. and Mrs. Frederick Kent Truslow, Helen J. Williams. *New Mexico*: James H. Turner. *New York*: Dean Amadon, Mr. and Mrs. Robert Arbib, Jr., John H. Baker, Mr. and Mrs. Winston Wm. Brockner, Eugene Eisenmann, Lois J. Hussey, Ralph S. Palmer, Catherine Pessino, Richard H. Pough, Wayne Short, Charles G. Sibley, Mrs. Dayton Stoner, Charles Vaurie, Jason A. Walker. *Ohio*: Mrs. Robert V. D. Booth, Ralph W. Dexter, Wesley E. Lanyon, Harold Mayfield, Milton B. Trautman. *Oklahoma*: Mr. and Mrs. F. M. Baumgartner. *Oregon*: Mr. and Mrs. Kenneth Gordon, Don J. Neff, Franklin W. Sturges. *Pennsylvania*: Frederick V. Hebard, M. Albert Linton, Elizabeth A. Taft, W. E. Clyde Todd. *South Dakota*: Mr. and Mrs. J. S. Findley, Nathaniel R. Whitney, Jr. *Tennessee*: Albert F. Ganier, J. C. Howell, Mrs. Amelia R. Laskey. *Texas*: Flossie Asher, Clarence Cottam, Margaret Louise Hill, Edgar B. Kincaid, Jr., Robert K. Selander, L. R. Wolfe. *Utah*: William H. Behle, Ronald A. Ryder. *Washington*: Ernest S. Booth, D. S. Farnier, George E. Hudson. *West Virginia*: Fred C. Brooks, Mr. and Mrs. Maurice Brooks, Earl N. McCue, Larry Schwab. *Wisconsin*: Daniel D. Berger, Mr. and Mrs. F. N. Hamerstrom, Jr., Alan Hamerstrom, Dorothy Joslyn, Joy Joslyn, Clarence S. Jung, Robert A. McCabe, Margarette E. Morse, Mr. and Mrs. A. W. Schorger. *Wyoming*: Mr. and Mrs. J. C. Warkley.

PUBLIC SESSIONS

Papers sessions were held in the morning and afternoon of each of the three days beginning Wednesday, September 5. The papers sessions on September 5 and 7 were held in Phipps Auditorium at the Denver Museum of Natural History and on September 6 in the Memorial Building of the University of Colorado at Boulder.

WEDNESDAY MORNING SESSION

The meeting was opened by an address of welcome by Carl A. Norgren, President of the Denver Museum of Natural History. Alden H. Miller, President of the American Ornithologists' Union, responded. Secretary, Harold F. Mayfield, summarized the results of the previous day's business sessions, including elections and awards.

Hybridization in Two Colombian Tanagers (*Ramphocelus flammigerus* \times *R. icteronotus*) (Slides). CHARLES G. SIBLEY, Cornell University, Ithaca, New York.
The Rediscovery of the Brazilian Merganser in Argentina (Slides). WILLIAM H. PARTRIDGE, Argentine Museum of Natural Sciences, Buenos Aires, Argentina.
Torpidity in the White-throated Swift, Anna Hummingbird, and Poor-will (Slides). THOMAS R. HOWELL, GEORGE A. BARTHOLOMEW, JR., and TOM J. CADE, Department of Zoology, University of California, Los Angeles, California.
The Breeding Biology of the Kirtland Warbler (Slides). JOSSELYN VAN TYNE, University of Michigan Museum of Zoology, Ann Arbor, Michigan.

WEDNESDAY AFTERNOON SESSION

A Trail Census at Itasca Park, Minnesota (Slides). S. CHARLES KENDEIGH, Department of Zoology, University of Illinois, Champaign, Illinois.

- The Ecology, Behavior and Systematic Relationships of *Xenospiza baileyi* (Slides). DWAIN W. WARNER, Museum of Natural History, University of Minnesota, Minneapolis, Minnesota.
- A Revision of the Botteri Sparrow, with Remarks on the Mexican Grasslands (Slides). J. DAN WEBSTER, Hanover College, Hanover, Indiana, and California Academy of Sciences, San Francisco, California.
- Stream Valley Birds in Relation to Elevation and Habitat near Gunnison, Colorado (Slides). A. SIDNEY HYDE, Western State College, Gunnison, Colorado.
- The Importance of Cottonwood Woodland for Colorado Plains Birds (Slides). RICHARD G. BEIDLEMAN, University of Colorado, Boulder, Colorado.
- Notes on the Singing and Nesting Cycle of *Brachyospiza capensis* (Slides). GEORGE J. WALLACE, Department of Zoology, Michigan State University, East Lansing, Michigan.
- The Beard of the Wild Turkey (Slides). A. W. SCHORGER, Department of Forestry and Wildlife Management, University of Wisconsin, Madison, Wisconsin.
- Ecological and Distributional History of Certain North American Bird Groups (Slides). M. D. F. UDVARDY, University of British Columbia, Vancouver, B. C.

THURSDAY MORNING SESSION

- Annual Pattern of Returns and Mating Combinations of the Chimney Swift (Slides). RALPH W. DEXTER, Department of Biology, Kent State University, Kent, Ohio.
- Behavior of Yellow-billed Magpies. JEAN M. LINSDALE, Hastings Reservation, Carmel Valley, California.
- Innate Differences in Reproductive Physiology in Subspecies of White-crowned Sparrows. ALDEN H. MILLER, Museum of Vertebrate Zoology, University of California, Berkeley, California.
- Timing of Molt in Steller Jays of the Queen Charlotte Islands, British Columbia (Slides). FRANK A. FITELKA, Museum of Vertebrate Zoology, University of California, Berkeley, California.
- A Study of a Cathbird Population. R. A. MCCABE, Department of Forestry and Wildlife Management, University of Wisconsin, Madison, Wisconsin.
- The Birds of Fort Carlton—In 1827, 1858, and 1956 (Slides). STUART HOUSTON, Yorkton, Saskatchewan, Canada.

THURSDAY AFTERNOON SESSION

- Races of the Mourning Dove—Their Distribution and Migration. JOHN W. ALDRICH and ALLEN J. DUVALL, U. S. Fish and Wildlife Service, Washington, D. C.
- Distribution, Feeding Habits, and Food of the Cattle Egret (*Bubulcus ibis*) in Puerto Rico. VIRGILIO BIAGGI, JR., College of Agriculture and Mechanic Arts, Mayaguez, Puerto Rico.
- Notes on the Horned Coot, *Fulica cornuta* Bonaparte. S. DILLON RIPLEY, Peabody Museum of Natural History, Yale University, New Haven, Connecticut.
- A Gigantic Fossil "Toothed" Bird (Slides). HILDEGARDE HOWARD, Los Angeles County Museum, Los Angeles, California, and (honorary) Santa Barbara Museum of Natural History, Santa Barbara, California.
- The Evolutionary History of the Loons (Slides). ROBERT W. STORER, University of Michigan Museum of Zoology, Ann Arbor, Michigan.
- The Distribution of the Western Red-bellied Woodpecker in the Missouri River Valley (Slides). WILLIAM F. RAPP, JR., Crete, Nebraska.

- The Nesting of the Wandering Tattler in the Brooks Range, Alaska, 1956 (Slides).
SIDNEY B. PEYTON, R. D. No. 2, Fillmore, California.
- Nesting Behavior of the Golden-crowned Kinglet (Motion Picture). ROBERT
GALATI, 345 Leicester Avenue, Duluth, Minnesota.

FRIDAY MORNING SESSION

- Adaptations in Hole-Nesting Birds (Slides). LARS VON HAARTMAN, Zoological
Institute, University of Helsingfors, Finland.
- Variation in Temporal Breeding Rhythm in Certain Californian Birds (Slides).
RICHARD F. JOHNSTON and FRANK A. PITELKA, New Mexico College of Agri-
culture and Mechanic Arts, State College, New Mexico, and Museum of Verte-
brate Zoology, University of California, Berkeley, California.
- The Nature of Feigning. FREDERICK V. HERARD, Philadelphia, Pennsylvania.
- Nesting Habits of the Acadian Flycatcher. RUSSELL E. MUMFORD, University
of Michigan Museum of Zoology, Ann Arbor, Michigan.
- Awakening Song of the Spotted Towhee (Slides). JOHN DAVIS, Hastings Reserva-
tion, Carmel Valley, California.
- Studies of Bird Repellents (Slides). JOHNSON A. NEFF, Wildlife Research Labora-
tory, Denver, Colorado.
- The New York State Standards for Recording Abundance, Frequency, and Seasonal
Occurrence of Birds (Slides). ROBERT S. ARBIB, JR., Federation of New York
State Bird Clubs, Freeport, New York.
- Studies of the Error in Bird Counting (Slides). ROBERT J. NEWMAN and STEPHEN
M. RUSSELL, Louisiana State University Museum of Zoology, Baton Rouge,
Louisiana.

FRIDAY AFTERNOON SESSION

SYMPOSIUM ON STUDIES OF BIRD SONG BY ELECTROMECHANICAL RECORDING
AND ANALYTICAL METHODS (RECORDINGS AND SLIDES)

WILLIAM R. FISH, COORDINATOR

- Analysis of Vocalizations in Eastern and Western Meadowlarks. WESLEY E.
LANYON, Department of Zoology, Miami University, Oxford, Ohio.
- Standards in Natural History Sound Recording. PETER PAUL KELLOGG, Laboratory
of Ornithology, Cornell University, Ithaca, New York.
- Song as an Isolating Mechanism in *Empidonax*. ROBERT STEIN, Cornell University,
Ithaca, New York.
- Species Recognition in Certain Thrushes. WILLIAM C. DILGER, Laboratory of
Ornithology, Cornell University, Ithaca, New York.
- Studies of the Song of the Bewick Wren. WILLIAM R. FISH, 608-A Kearsarge
Avenue, China Lake, California.

-
- An Avifaunal Survey of the Upper Headwaters of the Rio Tocantins, Central Goias,
Brazil (Slides). KENNETH E. STAGER, Los Angeles County Museum, Los
Angeles, California.
- Species Limits in the Genus *Campylorhynchus*. ROBERT K. SELANDER, University
of Texas, Austin, Texas.
- Territory of the Ovenbird as Related to the Food Supply. JUDITH STENGER, Uni-
versity of Toronto, Ontario.

Comparison of Courtship Display of Prairie Chicken and Black Cock. FREDERICK and FRANCES HAMERSTROM, Wisconsin Conservation Department, Plainfield, Wisconsin.

SOCIAL EVENTS

The Fellows and Council Members met for dinner on September 4. Members and guests were entertained at a reception in the Denver Museum of Natural History on the evening of September 6; motion pictures were shown: "Birds of Western New South Wales" by Patricia Witherspoon, and "Birds of Canton Island" by Alfred M. Bailey; these were followed by the traditional President's Coffee Hour.

The Annual Banquet was held on September 6 in the Memorial Building of the University of Colorado. Olin Sewall Pettingill, Jr., University of Michigan Biological Station, Cheboygan, Michigan, showed a motion picture, "The Shags of the Falkland Islands." Also a sound motion picture on European Woodpeckers was presented; the photography was by Heinz Sielmann and the commentary was by James Fisher, neither of whom was present.

FIELD TRIPS

On Saturday, September 8, visitors were taken by private cars through some of the high country of Colorado and up the highest auto road in the United States to the summit of Mount Evans, where many people saw White-tailed Ptarmigan and Rosy Finches. On Sunday, September 9, the group visited the Colorado prairies.

RESOLUTIONS

Whereas, The Whooping Crane, one of the most remarkable and spectacular birds of North America, is in imminent danger of extinction;

Therefore Be It Resolved, that the American Ornithologists' Union at its 74th Stated Meeting at Denver, Colorado, does hereby urge the United States Department of the Interior and the Congress of the United States to provide ample funds and facilities to permit full investigation of all methods whereby this bird may be saved from extinction; and

Be It Further Resolved, that copies of this Resolution be sent to the Secretary of the Interior, the Director of the U. S. Fish and Wildlife Service, the Director of the Bureau of the Budget, and to the respective Chairmen of the Senate and House committees on Interior and Insular Affairs.

Resolved, that the American Ornithologists' Union, assembled for its 74th Stated Meetings, takes this opportunity to express its deep appreciation of the kind hospitality shown and the careful, thorough planning of this very successful meeting by the Local Committee on Arrangements and by our three host organizations: the Denver Museum of Natural History, the Colorado Bird Club, and the University of Colorado Museum. Members of the Local Committee were as follows:

Denver Museum of Natural History: Alfred M. Bailey, Robert J. Niedrach, Fred Brandenburg, Ilva Jones.

Colorado Bird Club: Donald Thatcher, Dr. John L. Chapin, John Flavin, Jr., Ferd Kleinschnitz.

University of Colorado Museum: Dr. Hugo Rodeck, Dr. Gordon Alexander, E. R. Kalmbach.

Exhibits: William Traher, C. Waldo Love, Armintha Neal.

Finance: E. R. Kalmbach, Hugo Rodeck, Alfred M. Bailey.

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OF THE AMERICAN ORNITHOLOGISTS' UNION

	<i>Expiration of Term</i>
Ernst Mayr, <i>President</i>	1957
George H. Lowery, Jr., <i>First Vice-President</i>	1957
Austin L. Rand, <i>Second Vice-President</i>	1957
Harold F. Mayfield, <i>Secretary</i>	1957
Charles G. Sibley, <i>Treasurer</i>	1957
Robert W. Storer, <i>Editor of 'The Auk'</i>	1957

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Thomas R. Howell, <i>Cooper Ornithological Society Representative</i>	1957
Maurice Graham Brooks, <i>Wilson Ornithological Society Representative</i>	1957
James P. Chapin, 1939-42	} <i>Ex-Presidents</i>
Herbert Friedmann, 1937-39	
Ludlow Griscom, 1956	
Hoyes Lloyd, 1945-48	
Alden H. Miller, 1953-56	
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Stephen S. Gregory, <i>Chairman</i>	1957
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REPORT OF THE COMMITTEE ON BIRD PROTECTION TO THE AMERICAN ORNITHOLOGISTS' UNION, 1956

As anticipated, this has been a hectic year in conservation circles so far as national legislation is concerned. There are both good and bad things to report. On the whole, the good results outweigh the bad and to this extent represent progress.

The Upper Colorado River Storage Project was finally passed with Echo Park Dam in Dinosaur National Monument deleted, and in New York State conservationists resoundly defeated another attempt to invade the Adirondack wilderness area with the Panther Mountain Dam. Persistent attempts of the Army to get legislation (in spite of opposition of the Department of the Interior) giving them a large block of the Wichita National Wildlife Refuge lost when the House Committee failed to report out the bill. Incidentally, Congressman Wickersham from the Lawton district in Oklahoma, one of the sponsors of this legislation, was defeated in the Democratic primary. A carefully organized drive by commercial fisheries interests tried to destroy the Fish and Wildlife Service and take over the administration of all fisheries in the interests of the commercial operators. The final legislation kept the Fish and Wildlife Service united but divided it into a commercial fisheries unit and one for sport fish and wildlife.

More generous appropriations were given to the conservation agencies, including the Fish and Wildlife Service, the National Park Service, the Forest Service, and the Soil Conservation Service, so that they should be able to do a better job than before.

Federal lands around the Jim Woodruff Reservoir leased to the Florida Game and Fresh Water Fish Commission were saved for public use by last-minute legislation. The Corps of Engineers was proposing to resell them to former owners on give-away terms. A number of other bills seeking authority to dispose of federal lands on other reservoirs were prevented from passing by objections of conservation-minded members of the House. These are important because of the precedents that they might set.

A major conservation victory was the inclusion of forestry and wildlife conservation sections in the new Soil Bank agricultural bill which is now law. These were kept in the bill over the opposition of the National Lumber Manufacturers Association, which worked against them to the bitter end.

The federal pollution bill which was due to expire on June 30 has been replaced by a stronger and better law. The Public Health Service was given more money to carry the federal end; the enforcement features of the legislation were strengthened.

The worst defeat for conservation was the authorization of Bruce Eddy Dam on the Clearwater River in Idaho which was attached as a rider to the Omnibus Bill in the Senate. The President vetoed this record pork-barrel bill, and the Clearwater was saved for the present. However, an all-out fight by the conservationists will be required in the next session to prevent this invasion of one of the two remaining important salmon spawning tributaries of the Columbia River.

Two other meritorious pieces of legislation failed to get through the Senate in the closing hours, although both were passed by the House. The Key Deer bill failed when it was objected to by Senator Smathers, himself the author of the companion bill in the Senate. Congressman Engle (California) and all of his Committee introduced bills restricting the military land grabs and requiring the military to observe state laws when they hunted or fished on military lands. A good bill passed the House but failed passage in the Senate in the closing hours of the session.

Numerous other good conservation proposals failed somewhere along the line. It will be seen from this brief resumé that the House is much more conservation-minded than is the Senate, although there are a number of staunch conservation Senators. The House killed a number of bad bills that were passed by the Senate, including the one that would have given the Army the 10,700 acres of the Wichita Refuge and passed the two above-mentioned bills that were good conservation measures that failed in the Senate.

A rapidly growing number of members of the AOU have asked to be put on the conservation mailing list, and their response to bulletins on various legislative proposals has been both prompt and effective.

In other conservation activities, there are a number of items which deserve brief comment. Of growing concern is the rapidly increasing use of insecticides and herbicides in both the United States and Canada. This use is expanding before there is any adequate research on the effects of such sprays on wildlife and other valuable resources. Just at present, the province of New Brunswick, with a tremendous spruce budworm spraying program that is already known to have killed many young salmon in its most famous stream, is in the forefront of the news. This program is so carelessly supervised that the spray was recently reported to have killed all the fish in a fish hatchery.

Despite successful campaigns in a number of states to enact and enforce better laws protecting the valuable hawks and owls, the unrestricted killing still continues in Pennsylvania along many of the old shooting stands with the sole exception of the Hawk Mountain

Sanctuary. An educational campaign undertaken by the Pennsylvania Game Commission apparently has had little effect upon those who indulge in this illegal sport. The word *illegal* is used advisedly because the majority of the hawks and owls, despite an almost complete lack of enforcement of this section, are protected by Pennsylvania law. Maurice Braun recently called attention to this situation in an article in 'Nature Magazine' and emphasized that in spite of every effort made by conservationists to get better protection for these valuable birds, the slaughter still goes on.

Representatives of the International Committee for Bird Protection, in a recent report to the Pan American Section, outlined the sad state of wildlife affairs in most South American countries. To summarize their report briefly, except in Venezuela and Argentina, there is very little progress in conservation education and little or no law enforcement. From other sources we learned that Dutch Guiana is making progress.

In regard to the rare species with which many have been concerned in the past, there are no reports of any change in the status of the Condor and Ivory-billed Woodpecker. No information is yet available on the nesting success of the Whooping Cranes this year. Everyone is probably aware of the well publicized fact that the captive pair in the New Orleans zoo produced and hatched two eggs. One of the young disappeared and the other died, and so another year of failure in the efforts to breed these birds in captivity must be recorded.

Such reports as are available indicate that the situation of the Atwater Prairie Chicken becomes increasingly precarious as more land is developed for intensive agricultural purposes; and the long-continued drought and the low water levels in Okeechobee Lake have resulted in a disastrous nesting season in 1956 for many water birds as well as for the Everglade Kite. So far as is known, the kites succeeded in raising only three young, and many of the water birds failed to nest or did not succeed in bringing off young. If this drought continues into another year, the results could be disastrous.

Hudsonian Godwits, one of the rarer of the shorebirds, were reported in unusual numbers from national wildlife refuges in the Mississippi Valley in the spring of 1956. The greatest concentration seen in years was the 370 birds reported on the Squaw Creek Refuge in Missouri on April 25.

The Trumpeter Swan population is maintaining itself fairly well, and there are definite reports of swan nesting on the lower Copper River in Alaska, a fact which has been suspected for a number of years but which now seems to be confirmed.

The intensive studies the Fish and Wildlife Service initiated on the Ross's Goose have resulted in an estimate of about 12,000 wintering birds in 1955-56, a somewhat greater population than even the most optimistic estimates of previous years, and one which indicates that there may be some hope of saving this diminutive goose if some of its wintering areas can remain protected.

Since the establishment of the federal refuge system, particularly in Minnesota and the Dakotas, both Prairie Chickens and Sharp-tailed Grouse have nested on the marginal grounds around these waterfowl refuges. An intensive study last year on the Lostwood Refuge in North Dakota indicated a population of 17 Sharp-tailed Grouse to the square mile. This and other refuges in the territory are serving a double purpose of providing some protection to the prairie grouse as well as to the waterfowl, and efforts are being made to modify management practices to give these birds added help.

A report received by Phil DuMont of an expedition to Laysan Island indicates a definite increase in the number of rare Laysan Teal which are confined to that island only. On February 10, 1955, 161 of these birds were counted, and the party of observers secured several Kodachrome slides, one of which shows a flock of 52 of this species on the lagoon. The last previous count, in 1951, showed a population of about 39 birds.

The Cattle Egret which was mentioned in last year's report continues to thrive and spread. There are reports of this bird from Texas and Louisiana, as well as the huge flocks of nesting birds in Florida. They also have been reported from numerous places along the Atlantic Coast and up the Mississippi River valley.

IRA N. GABRIELSON, *Chairman*
Jean Delacour
Ludlow Griscom
Hoyes Lloyd
Roger Tory Peterson

GENERAL NOTES

A Hybrid between the White-throated Sparrow and the Slate-colored Junco at Dalton, Georgia.—A hybrid *Zonotrichia albicollis* × *Junco hyemalis* was collected in our yard in Dalton, Georgia, on January 16, 1955, by William W. Griffin. It was sent to Dr. John W. Aldrich, United States National Museum, Washington, D. C. It was also studied by Dr. David W. Johnston, Department of Biology, Mercer University, Macon, Ga., and by Dr. Alden H. Miller, Museum of Vertebrate Zoology, Berkeley, Calif. The specimen has been deposited in the latter museum.

Both species are common winter residents and regular visitors to our feeding station. The hybrid was first observed feeding with other birds in early November, and from then until mid-January we saw it almost daily at the feeding station, where it was aggressive toward both sparrows and juncos. Plainly evident was the White-throated Sparrow's striped back and white throat combined with the gray breast and white tail feathers of the Junco. The bill was shorter than that of either species and gave the appearance of being crossed. Later examination of the skin showed plain gray-brown crown with a slight streak of rusty-brown extending from each eye to nape; shoulders, back, and wings like the White-throat; breast and abdomen like the Junco; throat white with faint black streak on each side similar to the immature White-throat; and tail like the junco with two outer feathers white the last third of their length and edged with gray.

Dr. Aldrich concurred in our identification of the bird as a hybrid and pointed out other records in the literature of such a hybrid (Townsend, Bull. Nuttall Ornith. Club, 8: 78-80, 1883; Stone, Auk, 10: 213-214, 1893; and Snyder, Auk, 71: 471, 1954).

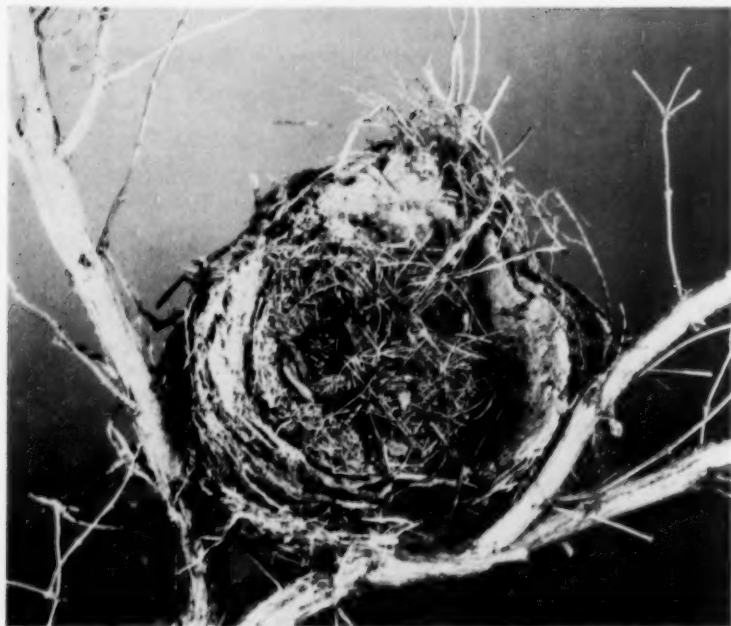
Dr. Miller provided the following measurements of the hybrid: Wing, 77.1; tail, 68.7; tarsus, 23.1; middle toe, 16.9; and hind toe, 8.7 mm. He writes, "The intermediacy of color and pattern features is pretty evident . . . I feel no doubt in regarding the bird as a cross between these two species. . . . The wing and tail measurements of the two species overlap so much that there is not a great deal to be discerned from these dimensions of the hybrid. Note, however, that the tarsus is much larger than in the Slate-colored Junco and quite clearly shows the influence of the White-throated Sparrow. The toe measurements reflect this also, but in less clear-cut fashion."

Dr. Johnston pointed out that "in all probability this hybrid came from *Zonotrichia albicollis* × *Junco hyemalis hyemalis*, and not *J. h. carolinensis*, because the ranges of the White-throat and Carolina Junco do not overlap. Furthermore, the genetic combinations perhaps produced a less viable organism. Witness, for example, the parrot-like bill, abnormally small for both species." Also, William W. Griffin noticed that the bird had only one testis, the left. He stated by letter, "I found nothing that resembled a right testis. The left testis measured 1 mm. in length."—MR. AND MRS. R. E. HAMILTON, 704 Greenwood Drive, Dalton, Georgia.

Occurrence of Bachman's Warbler (*Vermivora bachmani*) in northern Mississippi in June.—In view of the present rarity of Bachman's Warbler throughout its known breeding range and of the very few records for its occurrence in recent years, it seems advisable to put on record at this time an almost overlooked note relative to its presence in northern Mississippi during the late spring of 1940. On June 11, while engaged in field work concerned with the breeding birds of the state, I spent the morning in the Tricane Swamp, several miles northeast of Starkville. Possibly an hour after entering the Swamp I saw an adult male Bachman's Warbler. It attracted my attention by its characteristic song, and a short search soon revealed



A Hybrid between the White-throated Sparrow and the Slate-colored Junco,
collected at Dalton, Georgia, January 16, 1955.



Nest of Robin Showing Extreme Wear after having been used three times in one season. Photograph by Walter P. Nickell.

its presence feeding in the upper branches of a large tupelo gum. As there was a very good possibility that there was a nest close by, it was carefully watched for some thirty minutes as it fed overhead. During this interval it occasionally approached close enough to permit me to follow its restless movements without using my binoculars and to note its distinctive plumage with the naked eye. Rather unexpectedly it suddenly flew some distance away, and although I followed the direction it had taken I was unable to locate it again. Still hoping to find a nest with either eggs or young I spent the rest of the morning searching the numerous cane thickets that were a prominent feature of this swamp, but with no success. I was equally unsuccessful in seeing a female Bachman's Warbler. However, although this species has not heretofore been known to nest in Mississippi I feel that under the circumstances it is not improbable that it did breed in the Trincane Swamp in 1940, and possibly in previous years as well.—THOMAS D. BURLEIGH, *U. S. Fish and Wildlife Service, Moscow, Idaho.*

Robins Use Same Nest for Three Sets of Eggs in One Season.—On the Cranbrook Estate, Bloomfield Hills, Oakland County, Michigan, May 16, 1955, I found the nest of a Robin (*Turdus migratorius*). This nest was in the vertical fork of an eight-foot Tartarian honeysuckle (*Lonicera Tatarica*) 69 inches from the ground. The female was sitting on four eggs. At the next observation on June 3, the nest was empty, but showed feather scales from fledglings and the normal wear of the grass nest-lining materials. This nest was observed again on June 18 at which time the female was incubating three more eggs. The lining of the nest showed no signs of repair. At a later observation on July 23, this nest held three eggs and one young to which the egg shells were still clinging. On July 27, three 4-day-old young and one not more than two days old were in the nest. On July 30, the small young, which was dead, was removed from the nest and the remaining three young were banded. These banded young were still in the nest on the late afternoon of August 5. The total time from the discovery of the nest until the last observation was 82 days. Probably, the first two sets of egg produced young, which left the nest successfully as, in my experience, destruction of eggs or young causes the adults to abandon the nest immediately. Plate 6 shows the extreme wear of the nest during a period of an estimated 100 days without shelter from the time of its construction and without any noticeable repair. However, the season was much drier than usual so that the nest's mud cup was subjected to less softening than during a rainy season. Another factor which may have strengthened the nest was the well-constructed nest of a Catbird (*Dumetella carolinensis*) which served as its foundation.

The only other report of three nestings of a Robin in the same nest in one season I have found in the literature was by Edward A. Preble (MS) in Bent (*U. S. Natl. Mus. Bull.* 196: 21). No details were given.—WALTER P. NICKELL, *Cranbrook Institute of Science, Bloomfield Hills, Michigan.*

The Function of the Concealed Throat-patch in the White-necked Raven.—On 22 April 1955, while driving from Rio Grande City to Laredo in the Rio Grande Valley of Texas, I first made the acquaintance of the White-necked Raven (*Corvus cryptoleucus*). It was the courting season, and the some 40 birds observed during the day were mostly in pairs or threes, and were generally seen perched on the cross bars of telephone poles. The first birds seen were a pair billing and "carking"—it could not be called cooing—on a telephone pole near Falcón. Every now and then the breast, and at times also the throat, of one bird would flash out brilliantly white, especially, it seemed, when the other bird caressed its beak with its own. Later, of three birds on top of a telephone post, only the middle one showed the white, and

there was no evident courtship going on. A single bird "scratching" himself by the wing with his beak also revealed the white. The next day in the vicinity of Crystal City three separate pairs were seen, in each case sitting close together. We stopped to watch one pair and noted the white throat on both, appearing broad in one, narrow in the other; there was no billing. The birds were nearly always silent, but one that flew near at lunch time called "quarck" several times in a subdued, very flat tone, between the voice of a Fish Crow and that of a duck.

These observations indicate that the concealed patch of white on the throat and breast of the White-necked Raven functions in courtship and is not there merely to be revealed when the wind is blowing in the right direction, as some authors would suggest. I find no previous observation of this sort in any of the references dealing with the life history of this bird in Ridgway's *Birds of North and Middle America* or in any of the later works consulted. In fact, references to the observation of the concealed white feathers in living birds are so few that all of them that I could find have been brought together in the following paragraphs.

Herbert W. Brandt (*Texas Bird Adventures*, pp. 144-145, 1940), who is quoted by Bent (*Bull. U. S. Nat. Mus.* 191: 216, 1946), says: "It is then [early April] that the community takes to the sky, and the male especially is wont to perform in the air. . . . At that time his snowy-lined neck-piece becomes so enlarged that the feathers stand straight out like a fluffy boa, while those on his chin upturn at an acute angle, and the over-weening, black-bewhiskered rogue is then the picture, to his ebony admirer, no doubt, of a handsome, chivalrous swain." This poetical description of his appearance would lead one to believe that Brandt had observed the white on the birds while they were in the air, but two paragraphs further on (p. 145) he states: "Of the thousand [sic] of them that I have enjoyed watching, not one displayed to my eye other than jet." In his later and more elaborate work, *'Arizona and its Bird Life'* (1951), there is no mention of the observation of the white in life in any of the numerous text references, and in his systematic catalog (p. 671) he says: "In the field the thus termed 'white neck' of this raven never suggests itself to the eye." Evidently his description of the condition of the neck quoted above was based on specimens collected.

Shaler E. Aldous, who has made a more detailed study of this bird in the field than any other biologist, does not refer to any display of white in his brief account of courtship activities, but does say, when writing of field marks: "Occasionally, also, the white bases of its neck feathers can be seen when the plumage is ruffled by the wind." (*The White-necked Raven in relation to agriculture*. U. S. Dept. Int., Fish and Wildlife Serv., Research Rpt. 5: 4, 1942.)

Bendire (*Life Histories*, 1: 402, 1895) likewise does not refer to the exhibition of the white throat-patch except in a somewhat casual way, when remarking on the familiarity of the individuals around his camp near Tucson. "I remember one bird in particular (easily recognized by a white patch on the throat caused by the loss of some feathers) which visited my kitchen tent regularly."

Bradford Torrey, who had excellent opportunities for watching the bird in Arizona (but only in the winter), thought it worth while to make a special footnote record (*Nature's Invitation*, p. 191, 1904) of a bird he observed on top of a telephone pole facing a stiff breeze which blew the feathers of the throat apart to expose a snowy white patch the size of a silver dollar.

Since this note was written Miss Adele Koto of Beloit, Wisconsin, has shown me 2 or 3 kodachromes she took at Brownsville in January, 1956, which show the white of the throat revealed in a small patch by a strong wind.—S. F. BLAKE, 3416 North Glebe Road, Arlington, Virginia.

A Recent Colima Warbler's Nest.—Since the last previous nest of *Vermivora crissalis* was found in 1941 and one of the most recent reports on the species (Blake, Wilson Bull., 61: 65-67, 1949) includes the statement "Chisos population reported absent since 1946," more recent data seem to be worth publishing.

Ellen Stephenson and I reached Boot Spring Camp in the Chisos Mountains of the Big Bend National Park, Brewster County, Texas, at noon on June 22, 1954, with a study of the Colima Warbler (*Vermivora crissalis*) our principal objective. The camp consisted of a tar-paper cabin and several tents, while the steep hillside leading down to the dry stream bed was a dump, full of tin cans and rubbish. Walking up the stream side to the dam we found Colima Warblers in full song and realized that these were the unknown phrases heard in three places on the ride up to Boot Spring. To our ears the notes more nearly resembled those of the Pine Warbler (*Dendroica pinus*) than the Chipping Sparrow's (*Spizella passerina*) as it has been described in literature. The Pine Warbler-like trill was followed by two lower notes, the final one usually accented.

Later in the afternoon, sitting on the brink of the ravine beside the camp, I watched four Colima Warblers busily feeding among the small trees and shrubs, at eye level, and much of the time too close to permit the use of binoculars. They were moving quickly among the low oak and maple shrubs and were active and busy, though most authors describe their movements as slow and vireo-like. The most brightly marked bird once raised his crown like a Ruby-crowned Kinglet (*Regulus calendula*) displaying the rufous crest. Two of the other three showed no rufous on the crown. The most noticeable color on the birds was the yellow rump and crissum, which flashed so brightly in flight as to suggest the approach of an altogether more brilliant bird than the Colima Warbler.

In the early evening we went back to this vantage spot, and in a few minutes noticed one of the warblers disappear into the base of the steep ravine side, carrying a small green caterpillar. Looking where the bird had vanished behind a greasy paper sack, we found a nest with four well-grown young. These nestlings were well-feathered and showed vivid golden-lined mouths as they begged for food. When I attempted to pick one up for closer inspection, all four fluttered out of the nest, while both parents chipped excitedly around us. Since it was then 6:30 P.M. and becoming dusk, we left immediately, hoping that the parents would call the young back to the nest for the night. On the following morning, when we again investigated the area, the nest was empty and the young were not seen. We collected the nest, placed it in a rusty coffee can from the "dump" and packed it out on horseback.

Previous nests have been found in 1932 by Van Tyne (Univ. Mich. Mus. Zool. Misc. Publ., 33: 1-11, 1936), in 1933 by Sutton (Cardinal, 4: 1-7, 1934) and a Chicago Natural History Museum expedition which found four nests and collected one in 1941 (Blake, *op. cit.*). These are all from the Chisos Mountains and, except for Sutton's, from the Boot Spring area. The nest has never been found in Mexico, though the species is known from Coahuila, Tamaulipas, Michoacán, Sinaloa, Guerrero, and Jalisco (where the type and another specimen were taken on the Sierra Nevada de Colima). *Vermivora crissalis* has actually never been recorded from the state of Colima (Van Tyne, *in litt.*).

This fourth collected nest of the Colima Warbler was embedded in vegetation and rubbish at the base of the hillside, one side against a rusty tin can, and partly protected in front and from above by a greasy paper bag; other rubbish and trash littered the ground around. By the time the nest reached the Peabody Museum, after many hundred miles by car and by mail, it was somewhat oval in shape, but the measurements agree well with those given by Van Tyne for the first nest found.

The oval nest opening is more nearly 5.5×4.5 cm. than the 5 cm. diameter he mentions; the maximum depth, though the edges of the top had been somewhat broken by the active young, is the same, 4 cm. The nest is composed of fine grasses, with two small pieces of Arizona Cypress (*Cupressus arizonica*) on the outside; there are many small oak and maple leaves (tentatively identified as *Acer grandidentatum* and *Quercus emoryi*, when compared with material in the Harvard Herbarium by Dr. Stuart Harris). Two pieces of shredded cedar bark are loosely placed near the top, but only one small piece of moss, mentioned in other nests, is visible. The nest has been deposited in the Museum of Zoology, University of Michigan, with the type nest.

Blake (*op. cit.*) notes that in 1947 no Colima Warblers could be found in Boot Spring Valley. However the species has been seen in the area regularly from 1949 on, at least five birds being found in Boot Spring Canyon in 1953 (Peter Koch, Sprunt, Robert Fox, *in litt.*). On our ride back to headquarters we again heard Colima Warblers at lower elevations, making a total of eleven males heard singing, of which four were seen, one female, two birds showing no rufous on the crown, and four nestlings; a total of 18 birds of this species.

I am most grateful to Dr. Josselyn Van Tyne for information and suggestions as well as for his critical reading of this manuscript.—DOROTHY E. SNYDER, Peabody Museum, Salem, Massachusetts.

Cape May Warbler Feeds on Amphipods.—A warm front with a flow of moist southwesterly winds from the Gulf of Mexico assailed the New York City and Long Island area on October 2 and 3, 1954. Temperatures hovered in the 80s with the relative humidity rising to the low 90s.

On October 3, 1954, I arrived at Jones Beach State Park, L.I., N. Y. at 6:00 A.M. On the beach a dense fog greeted me, a fog that was so thick in places one could literally cut through it with a knife. The visibility was limited to some ten yards. Emanating from the fog overhead were heard many chips of warblers as they passed by. By 10:00 A.M. visibility improved somewhat, to 25 yards, and remained so until about 5:00 P.M.

Near the high-tide line, a small bird was noticed, fluttering around in a peculiar manner. Upon closer examination, it proved to be a Cape May Warbler (*Dendroica tigrina*), and it was chasing and catching some kind of prey. The warbler fluttered its wings as it skimmed and bounced along the sand in a jerky motion. As I watched it through my $10 \times$ glasses, I saw the bird successfully catch small whitish animals and swallow them. At times the warbler would stand motionless with one of the animals in its bill, and I managed to approach to within a few feet of the bird and see its food with great detail. These small animals were quite common on the damp sand and under piles of eel-grass. I collected a number and identified them as *Orchestia platensis*, a species of amphipod about 14 mm. in length ranging along the Atlantic Coast as far south as Florida (Pratt, Manual of the Common Invertebrate Animals, Revised Edition, 427, 1951).

Interspersed on the beach were small groups of fishermen who gave the impression of being detached from the land when viewed through the tenuous vapors of the fog. At times the Cape May would fly to these groups and flutter up their legs and equipment. To the warbler, the fishermen probably appeared as clumps of vegetation. The fishermen watched with amusement the antics of this small, strange bird.

While I had the warbler under observation for about 2 hours, it caught and ate some 25 amphipods.—WALTER DAWN, Bulls Island, Awendaw, South Carolina.

The Primaries of *Archaeopteryx*.—All who are interested in the origin of the birds or in bird flight will welcome de Beer's (1954) critical and finely illustrated study of *Archaeopteryx lithographica*. It is, of course, more than a study of the British Museum specimen, giving, to those who have had no chance to see them, valuable information on the Berlin specimen and on the beautifully preserved single feather described by von Meyer.

One point that de Beer does not clear up is the marked difference in appearance between the primaries of the British Museum and Berlin specimens. The two specimens are preserved in strikingly similar attitudes, with wings partly spread, the body turned slightly on the left side, and the head thrown back as if in an effort to avoid asphyxiation in the thixotropic mud on which it had landed and from which, lacking any appreciable degree of powered flight, it could not take off. The primaries of the Berlin specimen form a graded series, the medial being longest and the proximal and distal progressively shorter; and the proximal shafts curve forward and the distal ones backward; the whole combining to produce a surprisingly modern-looking wing tip that approaches the elliptical form seen in the passerines. In the British Museum specimen not only is the series more irregular, but the distal primaries are long and nearly straight.

Many apparent distinctions between the two specimens are shown by de Beer to be based on misconceptions. He finds the British Museum specimen to be about 10 per cent larger than the Berlin one in length of femur, tibia, humerus, radius, and ulna, but about 25 per cent larger in length of toes. Differences in age, sex, or degree of ossification might account for any of the observed discrepancies; and, in view of the numerous points of close agreement, de Beer is hesitant to accept the claims of generic or even specific distinction. In view of the many remarkable resemblances, the apparent discrepancy between the primaries demands attention.

The tail and left foot of the British Museum specimen are excellently preserved, and the specimen is of great value in several other characters that complement the Berlin one. Yet the more one studies the illustrations of it, the more impressed one must be with the amount of disintegration that took place before it was completely covered. It is possible that the tail and left foot were covered substantially before the rest of the animal. As de Beer indicates, the small displacement of several detached elements argues strongly against the animal having been preyed upon; but the right leg is detached and its foot missing, parts of the skull and most of the cervical vertebrae are missing, all the metacarpals are detached and some missing, and only four scattered phalanges remain of the fingers. This condition indicates a degree of disintegration that makes some displacement of the remiges probable if not inevitable.

The longer primaries of the Berlin specimen seem to be about 140 to 145 mm. long, if they are inserted about as we would expect. The lengths of the primaries and longer secondaries of the British Museum specimen are stated by de Beer to be about 130 mm., which would be disproportionately short for the longest primaries; but although, with the metacarpals displaced, exact measurement is impossible, I estimate that the longest primaries are over 150 mm. in length. The tips of three primaries of the right wing seem to be missing from the slab, which gives an illusion of a short, truncate wing tip. De Beer carefully studied the impression of the right wing of the British Museum specimen under critical illumination and concluded that it bore six primaries. He points out that some shaft impressions are double-struck, giving an appearance of a higher number. He suggests that the first primary, which is very short, had been recently replaced. Numbers 2 to 6 all appear to extend about the same distance, but this curious effect, as noted above, seems to be due to

appreciable amounts of the tips of numbers 3, 4, and 5 having been lost from the edge of the slab. Numbers 2 and 6 are of nearly equal extent, although the more distally attached number 6 is presumably substantially shorter than number 2. The impression of the left wing is fully within the limits of the slab, but the primaries are conspicuously disarranged. It is difficult to distinguish the demarcation between primaries and secondaries; but, on the basis of relative length, the most distal primary seems to correspond with number 5 of the right wing. Counting back from this point we find that what appears to be number 1 projects beyond number 2. This effect might be due to the loosening of number 1 from the elastic ligament; but, from the angles of the shafts, I suspect that these two feathers have crossed. Primaries 4 and 5 extend substantially beyond number 3; even allowing for some displacement it seems likely that they are the longest feathers.

In the Berlin specimen Heilmann (1926) counted 11 or 12 primaries, being uncertain whether a small feather that projects just beyond the claw of the second digit was a primary or a displaced covert. This feather shows very clearly in his excellent photograph (Figure 20) of the left wing. It is not obvious in available photographs of the right wing, but Heilmann indicates it in his drawing (Figure 2) of the complete specimen, and it is almost certainly a primary. As de Beer has suggested, Heilmann's high count seems to have been due to some shafts being double-struck. Examination of Heilmann's photograph of the left wing, in which the detail is exquisite, shows that the shafts that he labels 2, 4, 6 and 8 are quite precise duplicates of 1, 3, 5 and 7, and that they show no corresponding feather-tip impressions. They are quite clearly double-struck. After these first impressions were made the wing seems to have moved backward some 5 or 6 mm. into its final position. Water washing over the wing then obscured the original outline and penetrated under the margins of the wing enough to destroy the peripheral parts of the first impressions of the shafts. (This movement leads one to believe that Heilmann's count of secondaries may also have been high.) The wing accordingly bears 8 primaries, numbers 1 to 4 increasing smoothly in extent, number 5 being slightly shorter than 4, and 6 to 8 successively shorter in a regular sequence. The shafts of numbers 4 and 5 are nearly straight, whereas the three proximal primaries curve forward and the three distal ones curve markedly backward. The perfect symmetry of this wing tip and the agreement in general outline of the somewhat less sharply delineated right wing make it difficult to believe that any of these left primaries could be seriously displaced or that any could be missing.

The length and straight shafts of the primaries designated 4 and 5 by de Beer strongly suggest that they are fully homologous with the feathers to which I have designated these numbers for the Berlin specimen. It thus appears that primaries 6 to 8 of the British Museum specimen's left wing and 7 and 8 of the right wing were detached and washed or blown away before the bird was covered.

Heilmann, on the presumption that the Berlin specimen had 12 primaries, tentatively assigned numbers 1 to 7 to the second metacarpal (the third digit crossed distally below the second, and its metacarpal is assumed to have run beneath the primary shafts); number 8 was assigned to the 1st phalanx of the third digit; and 9 and 10 to the first phalanx and 11 and 12 to the second phalanx of the second digit. On the basis of 8 primaries we may tentatively assign numbers 1 to 5 to the second metacarpal, and 6, 7 and 8 to the first phalanx of the third digit and first and second phalanges of the second digit, respectively. If the distal portion of the elastic ligament rotted away as fast as the skin and tendons of the digits, it is not surprising that these outer primaries should have been detached. They are more likely to have been washed or blown far from the carcass than the digits; and when we con-

sider that all the digits of the right hand have been lost and only four scattered phalanges, two of them claws, remain of the left hand, we cannot wonder that the primaries borne on them have disappeared.

Acceptance of such a reconstruction of the wing of the British Museum specimen would support the correlations listed by de Beer and justify the inclusion of the Berlin specimen in *Archaeopteryx*. If, however, it be maintained that the impressions in the British Museum specimen represent the entire wing, not only must the Berlin specimen be left in *Archaeornis*, but the two genera must be regarded as rather distantly related despite their close skeletal resemblances. I find it hard to believe, however, that an arboreal, climbing bird, such as *Archaeopteryx* must have been, could have had long, straight distal primaries that would have seriously interfered with the use of its fingers.

It may be noted in closing that, from its narrow front web and the backward sweep of its shaft, von Meyer's isolated feather is seen to be a distal or subdistal primary. If it belonged to *Archaeopteryx* it must, from its size, have been number 7, according to my interpretation.

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- D. B. O. SAVILE, Botany and Plant Pathology Laboratory, Science Service, Ottawa, Ontario, Canada.

Merlin Attacks Brown-eared Bulbuls.—We were crossing a broad gravel-filled stream bed near Toyama, Japan, on the west-central coast of Honshu when a flock of Brown-eared Bulbuls (*Ixos amaurotis*) numbering about 70 birds approached upstream and crossed the river bed ahead of us. As they approached the bank a half a mile away a Merlin (*Falco columbarius*) appeared, flying parallel to our route, and headed toward the bulbuls. It reached them just as they left the river bed and were above a farm home surrounded by dense trees, mainly *Cryptomeria japonica*. The Merlin immediately attacked and the flock wheeled and circled about the trees attempting to avoid it. It stayed on the periphery of the flock attempting to isolate an individual or break up the flock. Oddly enough the bulbuls made no effort to alight in the trees but flew around and over them as though to confuse the falcon. The flock had been over a hundred feet high when attacked and in its frantic maneuvering gradually descended to nearly ground level. After a full three minutes of this an individual swung too far out of the flock and the Merlin stooped, taking it to the ground. The Merlin was only slightly larger than the bulbul which lay on its back pecking valiantly at the raptor. Undaunted by its ultimate fate it continued to fight until the Merlin flipped it over and quickly bit it at the base of the skull. Meanwhile the flock had regrouped and disappeared southward. The raptor, disturbed by us, flew heavily with its victim to a spot far out on the river bed. We decided from its small size and strong barring that it was an immature male.

Two days previously we had seen a Kestrel (*Falco tinnunculus*) work a flock of Gray Starlings (*Sturnus cineraceus*) in the same way, but it made no stoop. On previous years we had seen Kestrels and accipiters attack flocks of bulbuls in Kyushu.

—H. ELLIOTT McCLURE, 406th Medical General Laboratory, APO 500, San Francisco, California.

The Abbreviated Inner Primaries of Nestling Woodpeckers.—Under this title Chapin (Auk, 38: 531–552, 1921) placed on record his interesting discovery that in the juvenal plumage of many species of woodpeckers the first, or the first and second (i. e. inner) primaries are but a fraction of the adult size. These abbreviated primaries are molted early in the post-juvenal molt and replaced by feathers of normal size before the young birds leave the nest.

Out of 30 species examined, 9 were found to have two inner primaries reduced, 15 showed reduction of one, 1 species had a narrowed but not shortened first primary, and no reduction was found in 5 species.

Chapin discussed the probable significance of the abbreviated condition and concluded that, "It is probably an adaptation of some utility during early life in the limited space of the nesting hollow." J. T. Nichols suggested that the gap in the wing would allow the nest mates to thrust their heads readily through one another's wings and thus be better able to obtain food. A photograph of a nestling Flicker (*Colaptes auratus*) doing so was presented as evidence for this explanation.

A pertinent question, which Chapin asked, was why "do not other young birds reared in cavities in trees possess this same character?" The purpose of this paper is to offer an answer to this question and to suggest a possible mechanism and reason for the apparently random occurrence of the abbreviated inner primaries of nestling woodpeckers.

First, why should woodpeckers be the only hole-nesting birds to evolve reduced inner primaries in the juvenal plumage? The answer is, I suggest, associated with the fact that, unlike most birds, woodpeckers have a complete post-juvenal molt, in which the remiges are replaced, and which begins before the young bird leaves the nest cavity. The inner primaries are the ones involved because the primary molt sequence proceeds from inner toward outer, i. e., is centrifugal. Since the wings are not utilized until fledging occurs there is no selection pressure present during the nestling period to develop the flight feathers of the juvenal plumage *except those which otherwise would not have time to be dropped and replaced before fledging*. Since the post-juvenal molt begins before fledging, it is possible in some species for one or two of the juvenal inner primaries to be dropped and regrown before they are needed. Fledging apparently occurs at about the time that the inner primaries reach full size. In species which do not have a complete post-juvenal molt this arrangement could not evolve since the wing feathers would not be replaced during the post-juvenal molt. But why, one may ask, should this arrangement develop? Would it not be equally advantageous if the juvenal primaries grew to full size during the nestling period and were later replaced during the post-juvenal molt occurring after fledging? To answer this it is necessary to discover an advantage associated with having reduced inner primaries during the nestling period. Mr. Nichols' suggestion that the gap in the wing enables nest mates to raise their heads through one another's wings for feeding is certainly one advantage. As additional factors the following are suggested.

Since the inner one or two juvenal primaries are dropped and regrown to full size before being needed for flight there is no selection pressure present to cause these feathers to grow to full size. Selection against their full growth is derived from the fact that their absence or reduction lessens the physiological drain associated with feather growth, probably makes it easier for the nestling to fold the wing, and, to some degree, reduces the crowding in the limited confines of the nesting cavity. The first of these three possibilities is probably the most important; the metabolic saving resulting from not growing a useless feather should be of considerable importance.

As an answer to the second question, concerning the seeming randomness of occurrence of the abbreviated condition, the following is suggested. Since the fledgling requires an efficient airfoil for flight, selection would be against young which were fledged with a gap in the wing. The number of feathers involved and the extent of the reduction of the juvenal inner primaries is, therefore, probably correlated with the relationship between the time of fledging and the speed of the post-juvenal primary molt. The abbreviated condition of the inner primaries is an advantage to the nestling which becomes a disadvantage to the fledgling. The balance between these factors results in the apparently random variations found among different species in the extent of the abbreviated condition. In the sapsuckers (*Sphyrapicus*), the Lewis Woodpecker (*Asyndesmus lewis*), and the White-bellied Woodpecker (*Leuconerpes candidus*), Chapin found that there is no reduction in the size of the juvenal inner primaries. In these species it is likely that the post-juvenal molt does not begin soon enough to permit the juvenal inner primaries to be abbreviated during the nestling period but dropped and regrown before fledging. Chapin (*op. cit.*, p. 545) notes that a young Lewis Woodpecker, with a full-grown wing, showed, "no sign either of reduction of the inner primaries or of a beginning of post-juvenal molt." This seems to be admissible evidence in favor of the hypothesis offered above. Some statements by Bent, although not supported by incontestable evidence, suggest that the post-juvenal molt in the Lewis Woodpecker and the sapsuckers may not begin until after fledging. He states (Bull. U. S. Natl. Mus. 174: 229, 1939) that the post-juvenal molt of the Lewis Woodpecker begins in September, some two or three months after fledging and (p. 132) that the post-juvenal molt in the Yellow-bellied Sapsucker (*S. varius*) is accomplished by a series of partial molts which may begin in July, after fledging, and last until early spring.

Similarly, the species with one abbreviated inner primary are apparently those in which the post-juvenal molt begins early enough to allow time for one primary to be dropped and regrown while the species with two abbreviated juvenal inner primaries have a relatively still earlier post-juvenal molt. As previously noted, this hypothesis also explains why the inner primaries are the ones involved—simply because the primary molt begins with the inner primary and proceeds outward.

If this hypothesis is correct why should not other species having a complete post-juvenal molt have evolved a similar arrangement? A quick survey of available references containing information on molts does not reveal any other species in which the post-juvenal molt begins before fledging (Witherby, *et al.*, Handbook Brit. Birds, 1944; Dwight, Ann. N. Y. Acad. Sci., 13: 73-360, 1900). The reason why woodpeckers should be unique in this respect (if indeed they are) is probably related to their long period of nestling life. It is well known that the woodpeckers, and their relatives the toucans, honey-guides, and barbets, have relatively short incubation periods but exceptionally long periods of nestling development before fledging.

It seems possible then, that the abbreviated inner primaries of nestling woodpeckers are an adaptation to nest life, which also provides a metabolic saving, and that the evolution of this condition has been possible because of the unique combination of a complete post-juvenal molt, beginning with the inner primaries, and an unusually long period of nestling life.—CHARLES G. SIBLEY, *Department of Conservation, Cornell University, Ithaca, New York.*

The Loss of Teeth in Birds.—The fact that birds have lost their teeth during the course of evolution is well known but the adaptive advantages which prompted this loss are not known. Nearly every avian feature is concerned in some way with

adaptation for flight and this would suggest that the reduction and eventual loss of teeth also somehow favored this adaptation. Little has been ventured in the past by way of a possible explanation for this loss of teeth. The most prevalent idea at present seems to be that it was in response to the detrimental effects of the weight involved in possessing teeth and their attendant rather heavy supporting jaws, especially so far from the center of gravity.

Many present day forms have bills as heavy as, or heavier than, tooth-bearing jaws would necessarily be. This is probably a secondary condition that can exist because of the relative perfectness of other flight-adapted features. It may be that the ancestral types, not so perfectly adapted for flight as present forms, lost their teeth because any advantage making for better flight would be at a greater premium than at present. Once lost, it would be impossible for teeth to reoccur since they have been derived by a long process of evolution from placoid scales. Some modern forms have secondarily evolved "teeth" which are hooks or serrations of the horny coverings of the maxillae and mandibles. This demonstrates that teeth or tooth-like structures are still an advantage, particularly to some groups. The tooth-like structures present in modern forms are useful as meat-tearing structures or for holding active and or slippery prey. They are not, however, used for chewing.

I believe that another possible explanation for this loss of true teeth (admitting that weight reduction may be a partial explanation) involves the necessarily very high rate of metabolism of birds which is in turn a response to the flying habit. Such a high rate of metabolism necessitates the rapid ingestion of great quantities of food, usually of high caloric value. This in turn calls for rapid digestion and assimilation of this food. The more finely divided the food is the quicker it can be utilized. Teeth, of course, can process food into fine enough particles for rapid digestion if chewing is long enough, but rapid ingestion would then be impossible. Birds have evolved, instead, a muscular gizzard within which food is ground rapidly and finely with the aid of ingested grit. This permits the rapid and frequent ingestion of food which can be temporarily stored in the esophagus or crop while a relatively constant process of ingestion and digestion takes place.

Forms which are adapted to take foods which are easily digested such as flesh and nectar do not require this rather elaborate digestive system although many flesh eaters need "teeth" to aid in tearing their prey into small enough pieces to be swallowed. I think that it is likely that modern birds which do not need a muscular, grinding type of stomach have evolved from ancestral types which did because of increased demands for more rapid ingestion and digestion.

I suggest that the greater feeding efficiency of a grinding, muscular gizzard (developing along with the increasing necessity for a progressively higher rate of metabolism coincidental to greater flight efficiency) made teeth less necessary and led, consequently, to their reduction and final loss.—WILLIAM C. DILGER, *Laboratory of Ornithology, Cornell University, Ithaca, New York.*

Absence of Syrinx in the Turkey Vulture (*Cathartes aura*).—Dissection of the trachea of the Turkey Vulture shows no syrinx. The trachea branches into two bronchi much as in mammals, with no syringeal drum, no pessulus, and no wide expanses of membrane between cartilages or at the apex of the bronchi. The cartilages are very narrow, considering the size of the bird, none over 1 mm. in width. The bronchi consist not of half-rings of cartilage but of complete rings, the inner portion of each ring extremely fine, almost hair-like. Although very thin, these cartilages appear to give enough support to the internal bronchial membranes to

prevent sound-producing vibrations. There is no trace of internal or external muscles in the region of the bifurcation of the trachea, nor of the sterno-trachealis and tracheo-lateralis muscles. Evidently, therefore, the voiceless condition of the Turkey Vulture is due to structure and is not merely a matter of behavior.—
MILDRED MISKIMEN, *Miami University, Oxford, Ohio.*

Land Bird Migrants over the Florida Straits.—Recent interest in observations of land birds migrating over water prompts me to record the following events.

On May 6, 1955, at 7:30 A.M., I sailed from Havana, Cuba, for New York. The course that day was generally northeast, the noon position being 23° 58' N. by 81° 20' W. and at sunset we were about twenty miles off Miami. At first, there was a northeast wind; then we ran through a calm, following which, the wind sprang up from the west and it became slightly hazy. About sunset, it clouded over for thirty minutes but there was no rain. No unusual weather conditions had been evident on weather maps of the preceding five days.

During the morning, a few landbirds were seen, both on board and passing by to the northward. About 1:00 P.M., when we were well into the area of west wind, landbirds began to pass in increasing numbers. They were in groups of 5 to 15 and were headed between north and north-northwest. The majority flew about fifty feet above the water, but some flocks were just above the waves and some at an estimated two hundred feet. The flight continued unbroken until dark when there appeared to be a lull, though some birds were heard overhead and were seen passing through the lights about 9:30 P.M., at which time the flight direction was more northwesterly. It was estimated that 1800 warblers and 200 larger birds were seen. The great majority of birds paid no attention to the ship. A few landed briefly and then went on, while a very few were obviously exhausted and settled down. These gradually accumulated on board and about sunset the following count was made: 1 Barn Swallow; 1 flycatcher, probably a Wood Pewee; 1 Parula Warbler; 2 Cape May Warblers; 4 Black-throated Blue Warblers; 12 Prairie Warblers; 4 Blackpoll Warblers; 35 Palm Warblers, both Yellow and Western subspecies identified, Western much predominant; 40 Northern Waterthrushes; 35 Yellow-throats; 200 Redstarts; and 25 Bobolinks. These birds were absurdly tame, resting on chairs, hats, and even shoulders and hands of the passengers, exciting a great deal of interest.

As regards non-passerine birds, a single Ringnecked Plover appeared and rested briefly. About 6:00 P.M. a group of hawks, including 2 Sharp-shinned Hawks, 1 small buteo not satisfactorily identified, 2 Marsh Hawks, 1 Osprey, and 4 Sparrow Hawks, arrived. These remained around the ship about ten minutes but did not perch, except for one Sparrow Hawk which settled on the rigging momentarily. This same bird was observed to make a single unsuccessful attempt to capture a Redstart.

A similar group of birds but in much smaller numbers had been seen from ship on May 4 in the southeastern part of the Florida Straits, between the Bahamas and Cuba. On this day, Bobolinks made up a much higher percentage of the total; they were singing vigorously as they passed, the other birds calling occasionally but never singing. This singing of the Bobolinks while in flight was heard but less marked in the larger flight on May 6.

In view of the mild and essentially normal weather conditions, it is believed that this flight was not a case of storm-blown or "lost" birds but a part of the normal spring migration passing from the Bahamas and the eastern half of Cuba to Florida.

—NORMAN P. HILL, M.D., 2308 Highland Avenue, Fall River, Massachusetts.

Differential Mortality among Red Crossbills (*Loxia curvirostra*).—Coming over a rise in a country road north of Coudersport, Pennsylvania, at noon on December 21, 1955, I was upon a flock of seven Red Crossbills feeding in the road before I could stop my automobile. All seven birds arose sluggishly—4 males, 2 females, and 1 immature male. However, my car killed two of the birds, a female and the immature male. The remaining five birds settled in the road about 100 feet behind my stopped car.

About 15 minutes later I returned to the same spot. Only the four males remained feeding in the road. The last female was found dead alongside the road, her body still warm, the apparent victim of an automobile.

The greater mortality of females and immatures in this limited sample suggests that the same difference may obtain under natural predation, as has been shown in recent studies with other species (A. S. Mossman, Ph.D. Thesis, University of Wisconsin Library, 1955).

It is of further interest to note that along the same three-mile stretch of road and within 15 minutes of the above occurrences, three Evening Grosbeaks (*Hesperiphona vespertina*) and a flock of about 100 Pine Siskins (*Spinus pinus*) were also found. All were feeding in the road and moved sluggishly in the face of approaching traffic. The ambient temperature was 10° F. Extremely cold weather had prevailed over the entire country during the previous week. Snow Buntings (*Plectrophenax nivalis*) were also reported in the same area on December 19.—RICHARD R. BOND, *Department of Biology, Salem College, Salem, W. Va.*

Range Extensions in Puerto Rico.—On January 2, 1955, in the company of Dr. Frank Wadsworth, Agricultural Experiment Station, Rio Piedras, P. R., I observed three species of birds in the northeastern section of Puerto Rico, which merit recording. Between 45 and 50 Black-necked Stilts (*Himantopus himantopus*) were resting and feeding in a mangrove lagoon below Cabo San Juan Lighthouse. According to Bond's *Check-List of Birds of the West Indies* (1940) this species is "apparently not found in winter in Puerto Rico or in the Lesser Antilles, where, however, the species is known to breed." At Luquillo Beach among the Royal Terns (*Thalasseus maximus*) were two Gull-billed Terns (*Gelochelidon nilotica*), which are rare in winter in Puerto Rico. Right beside the lighthouse of Cabo San Juan was a flock of 150 to 175 Glossy Cowbirds (*Molothrus bonariensis*); the closest previous recorded location to Puerto Rico was on Vieques Island to the eastward where it is listed as "accidental." The arrival of this parasitic species, if permanent in such numbers and in fairly balanced sex ratio, can only be thought of as one more blight on the dimming conservation outlook for this island.—ROBERT L. GRAYCE, *Massachusetts Audubon Society, Boston, Mass.*

REVIEWS

Bird Navigation.—G. V. T. Matthews. Cambridge, Cambridge University Press. vi + 141 pp., 33 figs. in text. 1955. Price 12s 6d.

Travels and Traditions of Waterfowl.—H. Albert Hochbaum. Minneapolis, University of Minnesota Press. x + 301 pp., 26 figs. and many interpretive sketches in text. 1955. Price \$5.00.

These two books will both be valuable additions to the library of all ornithologists whose interests in birds extend beyond the label on a specimen or the tally at the bottom of a check-list. Each presents in authoritative fashion an important segment of the available knowledge of migration and navigation in birds. Both authors write from extensive experience with living birds, and both have taken full advantage of the published work of others. Although they approach these central problems of ornithology from quite different points of view, their books are complementary in the best sense; and the appearance of two such books during a single year demonstrates that real progress is being made in this field.

By the title "Travels and Traditions of Waterfowl" Hochbaum emphasizes the importance of individual experience and learning by the example of other birds of the same species. Much of his book is based directly on personal knowledge of ducks and geese in the Prairie Provinces, and he builds a convincing case for the development of long-distance migrations out of shorter flights on the breeding grounds. Local topographic factors, the learning of visual landmarks, and the influence of weather conditions are considered in sensible perspective, and general considerations are always tempered by numerous detailed accounts of specific first-hand observations. Some intriguing and original experiments with blindfolded birds released out-of-doors are described here for the first time. And finally there is a thoughtful discussion of the probable role in waterfowl of "tradition," the acquisition of behavior patterns and flight paths by learning from other more experienced birds.

Matthews' approach has been wholly an experimental one, and his book summarizes important contributions of information and theories concerning the sensory basis of orientation during the flights of birds over long distances, including both homing pigeons and wild birds such as the Manx Shearwater. As if to demonstrate that homing experiments can yield wonders equal to those observed in nature, Matthews presents the details concerning a Manx Shearwater which returned in twelve days from Boston, Massachusetts, to its home off the coast of Wales. Still more impressive has been the demonstration by Matthews and Kramer that Manx Shearwaters and certain colonies of homing pigeons consistently head in the home direction very soon after release in unfamiliar territory, regardless of the direction of transportation away from home. Matthews reviews all other homing experiments with birds, together with all important theories that have been advanced to account for bird navigation, although one could have hoped for a more adequate presentation of the important contributions of Kramer and his associates. Matthews then presents his own theory of sun-arc navigation, and closes with this evaluation of it: "No theory of the physical basis of bird navigation remains in the field except that involving the sun. This the evidence strongly supports, and the only type of sun navigation that fits the observed facts and is satisfactory from the logical point of view is that proposed by the sun-arc hypothesis. Even if future work proves this particular hypothesis faulty, it seems fairly certain that the final solution will have to be a reinterpretation of the way in which the sun's position in the sky can serve to give the bird its position relative to home."

The hypothesis which Matthews thus advances as a complete, if tentative, explanation for bird navigation is stated elsewhere in his book as follows: "The essential feature is the *sun arc*. This is inclined at an angle from the horizontal which is constant for a given place and is a measure of the latitude of that place. . . . The speed at which the sun moves round its arc is, for practical purposes, constant, at 15° an hour. When it has reached a particular point on its arc at home, it will have advanced further to an observer in the east, and less far to one in the west, the difference in arc angle (the angle round the arc from the noon position) being directly proportional to the change in longitude. At home the bird will become familiar with the features of the sun arc, and the sun's position on it at different (local) times. These will be related to the internal 'chronometer' which is also an essential part of the hypothesis. In unfamiliar surroundings the bird will have to construct the sun-arc from observation. The suggestion is that it observes the sun's movement over a small part of its arc and extrapolates to obtain the highest point. Measurement of the altitude of this point, the angle from the horizontal, and comparison with the remembered value for home, say, the previous day, will give the latitude change. The arc angle from the observed sun to this highest point when compared with that obtained at home for the same chronometer time will give the longitude change."

Many will find it difficult to believe that birds carry out so precise a kind of celestial navigation; and this point of view has been well stated by Aldous Huxley in an article in *Life* magazine which attempts to make a case for mental telepathy and the like: "there is the hypothesis that pigeons navigate by means of the sun. If they do, they must possess, built into their nervous systems, the equivalents of a chronometer, a sextant, navigational tables and a calculating machine for correlating the solar data observed at the point of release with those at the loft." It is at this point that Hochbaum's book makes one of its most important contributions to a more widespread understanding of such matters, and in particular to a more general escape from the pitfalls of inappropriate semantics. While Matthews uses the language of the navigator, albeit in simplified form, Hochbaum translates the same ideas into homely terms of the everyday lives of men or ducks, as in the following passage: "the traveler (like Joshua) perceives the sun moving relative to the earth. . . . A traveler who in autumn has moved several hundred miles toward the equator, for example, perceives that the sun rises at a steeper angle from the east, follows a higher arc across the sky, and drops more abruptly into the west. . . . A traveler accustomed to breakfast at sunrise, dinner at high noon, and supper at sunset would find that . . . if he went west from home, . . . the stomach would call for its dinner before the sun had gained its zenith."

If we are to think sensibly about these problems, we must strive somehow to bring together the analytical thinking typified by Matthews and the feeling for the realities of birds' lives so well expressed by Hochbaum's words and sketches. We must also avoid limiting our thinking by assuming that if birds orient with reference to celestial cues they must therefore employ the same mental processes as those used by the human navigator. The essential question is whether or not a given environmental cue, such as the sun's arc through the sky, is in fact perceived and used by birds to determine the direction of their flight.

Huxley succeeds brilliantly in confusing the issue. Imagine, for example, a full, technical statement of all of the physiological events which occur with split-second precision as a man plays tennis or a phoebe catches a flying insect. These events could easily be made to sound far more complex than the hypothesis of sun-arc navigation by birds.

Matthews' hypothesis will stand or fall as a result of the further experimentation which it will certainly help to stimulate. Among the essential questions still to be answered are these: Can birds judge the sun's altitude above the horizon with a precision of perhaps one minute of arc? Can they determine the slope of the sun's path across the sky with the required precision, even when they see it for only a minute or two before flying off from the release point in approximately the home direction? Does their "internal chronometer" have the necessary accuracy? And finally, the largest question of all from the point of view of the field ornithologist, what about migratory flights at night or under an overcast?

The first two of these questions should be susceptible to direct, experimental test, especially if those interested in these problems can take advantage of modern techniques of conditioning birds in order to bring out their full sensory capacities. Human and avian visual acuity certainly approaches or even exceeds plus or minus one minute of arc (see for example Donner, K. O. *Acta Zoologica Fennica*, **66**: 1-40, 1951). But these values have been obtained in experiments where the bird or man was asked merely to distinguish two points from one, or thin black and white stripes from a uniform gray which results when their width subtends too small an angle at the observer's eye. It is quite another matter, for a human observer at least, to judge with equal precision a large visual angle, such as the altitude of the sun above the horizon.

Regarding the "internal chronometer" there has been available for a long time substantial evidence that birds and many other animals keep track of the time of day under constant environmental conditions, in the sense that they become active at a definite time even in the absence of external indications of time. This evidence is well reviewed in Matthews' book, insofar as it applies to birds; and, more recently still, significant experiments have also been described by Hoffmann (*Naturwissensch.*, **40**: 608-609, 1953), and Rawson (*Zeitschr. f. Tierpsychol.*, **11**: 446-452, 1954). A fairly accurate internal time-keeping process seems the most plausible of Matthews' assumptions.

To the obvious difficulty that much migration and homing occur when the sun is not available to view, Matthews replies by pointing out that in some of his experiments homing was very poor indeed during several days of constant overcast. He goes on to suggest, "The fact that migrants continue to pass over in the 'standard' direction when the sky is overcast is no real objection. The direction could well have been determined by an earlier view of the sun and maintained in the cloudy interval with reference to general topography." On the whole, Matthews' theory stands as a provocative challenge for future investigations; but until its foundations are bolstered by more substantial evidence it can scarcely be accepted as more than a partial explanation of bird navigation.—DONALD R. GRIFFIN.

Sea Birds.—James Fisher and R. M. Lockley. Houghton Mifflin Company, Boston. xvi + 320 pp., 40 black and white plates, 9 color plates, 66 text-figures. Price \$6.00.—This excellent book deals with the 85 "primary" sea birds (procellariiform, pelecaniiform, and some charadriiform species) and also with the 31 "secondary" sea birds (gaviiform, anatid, and phalaropodid species) inhabiting the North Atlantic Ocean as breeding populations. The authors are well-known British specialists on oceanic birds. Slightly more than half the book is devoted to consideration of problems investigated by modern ornithologists; chapters include material on the North Atlantic as bird environment, evolution in sea birds, demographic phenomena, movements, navigation, and social and sexual behavior. The remainder of the text proper is concerned with life history information presented group by group.

Appendicular material is composed of a distributional list of sea bird species, a selective bibliography, and indices to authorities and vertebrate species mentioned in text.

One way this book could be improved would be to increase its size. As it is, however, all important fact, knowledge, and hypothesis concerning North Atlantic sea birds as of 1954 is within the covers, and an increase in size would simply afford fuller documentation, not to mention more good reading.—RICHARD F. JOHNSTON.

Variation, Relationships and Evolution in the *Pachycephala pectoralis* Superspecies (Aves, Muscicapidae).—Ian C. J. Galbraith. Bull. Brit. Mus. (Nat. Hist.), Zool. Ser., London, vol. 4, no. 4, pp. 133–222, maps. September, 1956. Price, one pound four shillings.—An evolutionary review of geographical variation in the bird that is commonly said to have more subspecies than any other. The author finds that variation patterns are best shown after suppressing slight subspecies, and suggests that this may be true of birds in general. Some forms of *pectoralis*, known to intergrade, are much more distinct than are some full species of the same genus that live side by side on New Guinea. Clines, presumably adaptive, are visible on continents (Australia) but barely hinted at in island populations, which vary more sharply and irregularly. Many other interesting suggestions and conclusions.—DEAN AMADON

Methods and Principles of Systematic Zoology.—Ernst Mayr, E. Gorton Linsley, and Robert L. Usinger. (McGraw-Hill, New York), ix + 328 pp., 45 figures in text. Price, \$6.00.—Too few non-systematists understand the job of the systematist. Briefly, it is to fit a man-made system of taxonomic categories or pigeon-holes to a world of organisms whose kinds span an immense range of diversity. The inherent difficulties of trying to fit this rigid system to a natural phenomenon as plastic as the world of life have been the cause of many controversies among systematists, and these in turn have given outsiders the impression that taxonomy, as it is practiced now, is more of an art than a science. For a long time, we have needed a text in which the fundamentals of both the theory and practice of taxonomy are set forth. Mayr, Linsley, and Usinger have designed a book to fill this gap. They begin with a short history of taxonomy and discussions of taxonomic categories. The largest part of the book is nearly equally divided between a series of chapters on taxonomic procedure and a series on zoological nomenclature. A bibliography, a glossary, and an index complete the work.

This text is addressed to students of systematics, but it will also be a valuable source of information to the non-systematist who wants to gain an understanding of the theory and practice of taxonomy.—ROBERT W. STORER.

A Laboratory and Field Manual of Ornithology.—Olin Sewall Pettingill, Jr. (Burgess Publishing Co., Minneapolis), viii + 379 pp. 1956. Price, \$5.00.—This well-known manual has been carefully revised, greatly enlarged, and brought up to date. The approach, as before, is one of "classical" ornithology, and consequently, several important aspects of avian biology, such as myology, displays, convergent evolution, and adaptation (beyond the foot-and-bill level) are treated inadequately or are omitted entirely. The extensive list of references to the literature of ornithology will prove particularly valuable for the beginner, and the work will undoubtedly be used even more than it has been in the past for the teaching of ornithology.—ROBERT W. STORER.

RECENT LITERATURE

EDITED BY FRANK MCKINNEY

BEHAVIOR

- ALTMANN, S. A. 1956. Avian mobbing behavior and predator recognition. *Condor*, 58: 241-253.—The behavior of 39 species of wild birds was noted as they were exposed to different species of stuffed owls. Mobbing behavior was studied from the standpoint of previous contact of the species or individual with the predator. At least in the case of *Dendroica auduboni*, mobbing behavior is believed to be innate. Several pages tabulate individual responses of different species to different owls.—D. W. J.
- ANDREW, R. J. 1956. Territorial behaviour of the Yellowhammer, *Emberiza citrinella*, and Corn Bunting, *E. calandra*. *Ibis*, 98: 502-505.—Little food-resource function is postulated for territory in these species. The major function seems to lie in the formation and maintenance of the pair-bond.—R. F. J.
- ARMSTRONG, E. A. 1954. The ecology of distraction display. *Brit. Journ. Animal Behaviour*, 2: 121-135.—A detailed review of the literature on distraction display. "Principles correlating the incidence of distraction displays and the type of nesting habitat are formulated." Aspects of the adaptive value, evolution, and causation of these behavior patterns are discussed.—F. M.
- ARMSTRONG, E. A. 1956. Territory in the Wren, *Troglodytes troglodytes*. *Ibis*, 98: 430-437.—"The natural conclusion is that territorialism is the stereotyped expression of . . . [threat and epigamic display], with reference, usually, to the site, actual or potential, of reproductive activity."
- BEACH, F. A. 1951. Effects of forebrain injury upon mating behavior in male pigeons. *Behaviour*, 4: 36-59.—"It is suggested that the forebrain contributes to the male's sexual performance by maintaining a high level of responsiveness to sexual stimuli. Coitus may survive postoperatively if the operation is not too severe and if the individual was highly reactive before brain injury. Injections of androgen tend to increase sexual excitability and may therefore revive copulatory ability in brain-operated pigeons provided the preoperative responsiveness was high and the lesion not too extensive."
- BLANK, T. H., and J. S. ASH. 1956. The concept of territory in the Partridge *Perdix p. perdix*. *Ibis*, 98: 379-389.—Concepts of classical territoriality do not apply to this species; covey territory, which travels with the birds and is not defended, and pair territory, which apparently occasionally is defended, are defined.—R. F. J.
- CONDER, P. J. 1956. The territory of the Wheatear, *Oenanthe oenanthe*. *Ibis*, 98: 453-459.—Territory is held for life by pairs; size varies inversely with population density. The main function seems to be facilitation of breeding; territory as foraging ground is thought to be secondary.—R. F. J.
- DUNNETT, G. E., and R. A. HINDE. 1953. The winter roosting and awakening behaviour of captive Great Tits. *Brit. Journ. Animal Behaviour*, 1: 91-95.—A comparison of the behavior of captive and wild birds throws light on the factors which influence time of roosting and awakening. The strength of the feeding and sex drives is shown to influence the daily rhythm.—F. M.
- DURANGO, S. 1956. Territory in the Red-backed Shrike, *Lanius collurio*. *Ibis*, 98: 476-484.—Territory size is extremely variable, depending on population density. The function of territory seems to be primarily that of food reservation.—R. F. J.

- GIBB, J. 1956. Territory in the genus *Parus*. *Ibis*, 98: 420-429.—A survey of territoriality in *Parus major*, *P. palustris*, *P. montanus*, *P. atricapillus*, and *P. inornatus*. Territorial behavior, functions and sizes of territories, and territory as a limit to density are discussed.—R. F. J.
- GIBB, J. 1956. Food, feeding habits and territory of the Rock Pipit, *Anthus spinoletta*. *Ibis*, 98: 506-530.—Breeding density is 5 to 10 pairs per mile of coastline in Cornwall. Foraging areas in and above the intertidal zone are used varying through the year; 50 per cent of the records in December come from the intertidal. The most common winter foods are *Littorina neritoides*, chironomid and other dipterous larvae, and isopods (*Idotea*). Territories are held by pairs in the breeding season and by individuals in the winter. Breeding territoriality ceases in July and winter territories are established by September. The function of territory in winter seems to be for reservation of food; at this time it probably also limits density.—R. F. J.
- GOODWIN, D. 1952. A comparative study of the voice and some aspects of behaviour in two Old-World jays. *Behaviour*, 4: 293-316.—*Garrulus glandarius* and *G. lanceolatus*.
- GUHL, A. M. 1956. The social order of chickens. *Scientific American*, 194 (2): 43-46.—A popular account.—J. C. H.
- HALE, W. G. 1956. The lack of territory in the Redshank, *Tringa totanus*. *Ibis*, 98: 398-400.
- HINDE, R. A. 1956. The biological significance of the territories of birds. *Ibis*, 98: 340-369.—A review of the literature and an introduction to a symposium on bird territory in the *Ibis*, vol. 98, no. 3.—R. F. J.
- HOFFMANN, E. 1954. Black Terns at Big Muskegs. *Passenger Pigeon*, 16: 3-8.—Behavior notes obtained during some 20 years of banding Black Terns on a Wisconsin lake.—R. W. N.
- LANYON, W. E. 1956. Territory in the meadowlarks, genus *Sturnella*. *Ibis*, 98: 485-489.—The meadowlarks defend territory intraspecifically and between the two species. No difference can be detected in territorial behavior directed intraspecifically or interspecifically.—R. F. J.
- MARLER, P. 1956. Territory and individual distance in the Chaffinch, *Fringilla coelebs*. *Ibis*, 98: 496-501.—Breeding territories are defended. Their function seems not related to food resource. Individual distance is a small area surrounding a bird and within which intruders are rarely tolerated; it may be an evolutionary forerunner of territory.—R. F. J.
- MARSHALL, A. J. 1956. Bower Birds. *Scientific American*, 194 (6): 48-52.—An account of the different types of bowers and the behavior of the two sexes as it relates to the bower.—J. C. H.
- MCCARTAN, L., and K. E. L. SIMMONS. 1956. Territory in the Great Crested Grebe *Podiceps cristatus* re-examined. *Ibis*, 98: 370-378.—Main area of defense is immediately around the nest, but some additional open water may be defended; population density and ecological condition of the marsh probably determine what is defended.—R. F. J.
- MOUNTFORT, G. 1956. The territorial behaviour of the Hawfinch *Coccothraustes coccothraustes*. *Ibis*, 98: 490-495.—Colonially breeding Hawfinches do not show classical territoriality, but the area within which breeding occurs is defended from presumed predators in unison by members. Solitary breeders show typical territoriality but hold only small areas in defense.—R. F. J.
- PETTERSSON, M. 1956. Diffusion of a new habit among greenfinches. *Nature*, 177

- (4511): 709-710.—These finches strip the shrub, *Daphne mezereum*, in May and early June while the fruits are still green. The birds can crack the immature stone and devour the large seed. This new behavior seems to be increasing rapidly; 42 per cent of the known cases occurring within the last two seasons.—H. C. S.
- RADFORD, M. C. 1955. Nuthatch roosting times in relation to light as measured with a photometer. *British Birds*, 48: 71-74.—No relation between roosting time and light intensity or temperature could be found. Roosting was earlier in February and March than in November and December, as in Great Tits.—M. T. M.
- SABINE, W. S. 1956. Integrating mechanisms of winter flocks of Juncos. *Condor*, 58: 338-341.
- SIMMONS, K. E. L. 1952. The nature of the predator-reactions of breeding birds. *Behaviour*, 4: 161-171.—"It is maintained that the various reactions, except attack and fleeing themselves, are the outcome of the simultaneous activation of the antagonistic aggressive and escape drives at different levels of integration and threshold due to, among other factors, the stage of the breeding-cycle and the nature of the predator." Displacement activities are discussed and most of the examples deal with shorebirds.—F. M.
- SIMMONS, K. E. L. 1954. The advertising behaviour of the Great Crested Grebe. *Bird Study*, 1: 53-56.—Apparently unmated birds and paired females (at least) give a special call usually when alone in the territory. Causation and function are discussed and comparisons are made with other species of birds.—F. M.
- SIMMONS, K. E. L. 1955. The Nature of "Anting." Letter. *British Birds*, 48: 94-96.—A disagreement with Poulsen's theory which implies anting is primarily a form of feeding. However, many species never eat the ants and the behavior often involves the use of stereotyped patterns. Anting movements are modified preening movements just as dust-bathing movements are partially adapted water-bathing movements.—M. T. M.
- SIMMONS, K. E. L. 1956. Territory in the Little Ringed Plover, *Charadrius dubius*. *Ibis*, 98: 390-397.—Territory is defended in these plovers against their own species and also against *C. hiaticula* and *C. alexandrinus*. The function of this is postulated as spacing of the nests of the three species so that large-scale egg-nestling predation is unlikely.—R. F. J.
- SNOW, D. W. 1956. Territory in the Blackbird *Turdus merula*. *Ibis*, 98: 438-447.—Average size of territories is 0.4-0.6 acres; suitable cover for the nest seems to be the main requisite of a territory. Old males hold territory through the year and young males assume territories in their first fall, although these are not fully established until the beginning of the next breeding season. The function of territory seems to be related chiefly to efficiency in breeding and not with food-getting.—R. F. J.
- STEVEN, D. M. 1955. Transference of "imprinting" in a wild gosling. *Brit. Journ. Animal Behaviour*, 3: 14-16.—A wild *Anser erythropus* gosling, between one and two weeks old, was captured in Norway. Within one week, the gosling had become imprinted on its four human captors. The transference of imprinting from the parent geese is thought to be correlated with habituation as seen in the gradual disappearance of fear.—F. M.
- SWANBERG, P. O. 1956. Territory in the Thick-billed Nutcracker *Nucifraga caryocatactes*. *Ibis*, 98: 412-419.—Territory is held throughout the year and for the length of life of the individual. All activities (foraging, food storage, singing,

- and nesting) take place in territories; these average 32.7 acres in size in Sweden.—R. F. J.
- TINBERGEN, N. 1956. On the functions of territory in gulls. *Ibis*, **98**: 401-411.—The species studied were *Rissa tridactyla*, *Larus ridibundus*, and *L. argentatus*. Territory is taken to involve both site attachment and hostility, and eight functions of territory provisionally are presented within this context.—R. F. J.
- TOWE, A. L. 1956. Efficacy of striatal shocks in avian conditioned behaviors. *Science*, **123** (3204): 936-937.—Stimulation of the neostriatum intermediale of the pigeon was used successfully to condition one individual to flex its leg.—J. C. H.
- VON HAARTMAN, L. 1956. Territory in the Pied Flycatcher, *Muscicapa hypoleuca*. *Ibis*, **98**: 460-475.—Territorial behavior arises after males find nesting-holes. Since it is chiefly the nest-hole that is defended, territories are small and density is limited by the number of nest-holes. Most males have more than one territory and it is these males that can be polygynous.—R. F. J.
- YOUNG, H. 1956. Territorial activities of the American Robin *Turdus migratorius*. *Ibis*, **98**: 448-452.—A condensation of the author's earlier (1951) published work.

DISEASES AND PARASITES

- CARRIKER, M. A., JR. 1954. The Menoponidae of the Cracidae and the genus *Odontophorus*. (Neotropical Mallophaga Miscellany No. 8). Noved. Colombianas, no. 1: 19-31. Univ. del Cauca, Popayan.—Describes two new genera, a new species, a new subspecies, and provides three new names in substitution for those preoccupied, for certain bird-lice.—E. E.
- EADS, R. B. 1956. Ectoparasites from swallow nests, with the description of a new ceratophyllid flea. *Journ. Parasit.*, **42**: 73-76.—A mite, a flea, and a tick were common on nests of *Petrochelidon fulva* in central Texas caves; the tick was also found on Common Cliff Swallow nests on buildings.—J. D. W.
- FARR, M. M. 1954. Renal coccidiosis of Canada Geese. *Journ. Parasit.*, **40** (5, Sect. 2): 46.—A common pathogenic parasite and, probably, mortality factor.—J. D. W.
- GROUPÉ, V., F. J. RAUSCHER, and W. R. BRYAN. 1956. Suppression and modification of virus-induced Rous sarcoma in chicks by xerosin. *Science*, **123** (3207): 1073-1074.
- HUGHINS, E. J. 1956. Ecological studies on a trematode of bullheads and cormorants at Spring Lake, Illinois. *Trans. Amer. Micr. Soc.*, **75**: 281-289.
- JUNGHERR, E., F. SUMMER, and R. E. LUGINBUHL. 1956. Pathology of egg-adapted avian encephalomyelitis. *Science*, **124** (3211): 80-81.
- KISSLING, R. E., R. W. CHAMBERLAIN, D. B. NELSON, and D. B. STAMM. 1955. Studies on the North American Arthropod-borne encephalitides. VIII. Equine encephalitis in Louisiana. *Amer. Journ. Hygiene*, **62**: 233-254, 1 fig.—Near Ponchatoula, Tangipahoa Parish, southern Louisiana, blood (cardiac) samples from 1421 birds of 104 species were collected from April, 1952, through June, 1953. Virus of eastern equine encephalitis was isolated in single specimens of Catbird, Cardinal, and Hermit Thrush; antibody was found in from 7.4 to 22.7 per cent of all of the birds examined, varying according to the seven areas from which samples were obtained. Virus of western equine encephalitis was found in one Loggerhead Shrike, one Carolina Chickadee, and one Cardinal, with antibody in 2.8 to 27.2 per cent of the remainder. Migrant birds that go into the tropics in winter appear to have a higher antibody rate than species resident in Louisiana.

- MACY, R. W., D. J. MOORE, and W. S. PRICE. 1955. Studies on dermatitis-producing schistosomes in the Pacific Northwest, with special reference to *Trichostrongylus oregonensis*. Trans. Amer. Micro. Soc., **74**: 235-251.—Cercariae of two species of flukes, found in ducks and geese, commonly cause swimmers' itch; life cycle of one experimentally demonstrated.—J. D. W.
- ORMEÑO, B. E. P. 1953. *Phalacrocorax bougainvilli*, "Guanay," un nuevo huésped para *Cyathostoma sphenisci* Baudet. Pub. Mus. Hist. Nat. "Javier Prado," Ser. A. Zool., no. **14**, 6 pp., 1 pl.—*P. bougainvilli* is a new host for the nematode, *C. sphenisci*.—M. A. T.
- ROBINSON, E. J. 1955. Observations on the epizootiology of filarial infections in two species of the avian family Corvidae. Journ. Parasit., **41**: 209-214.—Vector of two species of filerine, in Crows and Blue Jays, apparently *Culicoides*, with transmission during nest life.—J. D. W.
- SAUNDERS, D. C. 1955. The classification of microfilariae in birds. *Avifilaris tyrannidarum* and *A. fringillidarum*, two new species. Trans. Amer. Micro. Soc., **74**: 37-45.—Heart blood of 1600 birds of many species from Mexico examined for microfilariae; 21 host species infected.—J. D. W.
- SCHILLER, E. L. 1955. Some cestode parasites of the Old Squaw, *Clangula hyemalis* (L.). Proc. Helm. Soc. Wash., **22**: 41.—Five species recorded in arctic Alaska.
- SCHILLER, E. L. 1955. Studies on the helminth fauna of Alaska. XXIII. Some cestode parasites of Eider Ducks. Journ. Parasit., **41**: 79-88.—Many Steller's, Pacific, King, and Spectacled eiders examined. Thirteen species reported, of which two described as new and four redescribed.—J. D. W.
- SPRENT, J. F. A. 1954. The life cycles of nematodes in the family Ascarididae Blanchard, 1896. Journ. Parasit., **40**: 608-617.—Phylogeny with respect to life cycles discussed; bird parasites have an intermediate host (fish, tadpoles, earthworms, shrews, moles, hedgehogs) which must be eaten by the final host (cormorants, ducks, herons, hawks, owls).—J. D. W.
- TATE, P. 1954. Notes upon the biology and morphology of the immature stages of *Neottiophilum praeustum* (Meigen, 1826) (Diptera: Neottiophilidae) parasitic on birds. Parasitology, **44**: 111-119.—Maggot is blood sucker in nests of fringillids; heavy infestations cause mortality.—J. D. W.
- WEBSTER, J. D. 1955. Three new forms of *Aploparaksis* (Cestoda: Hymenolepididae). Trans. Amer. Micro. Soc., **74**: 45-51.—From Red-backed Sandpiper in Alaska and Varied Thrush, locality unknown.

DISTRIBUTION

- BAILEY, A. M. 1955. Birds of New Zealand. Mus. Pictorial (Denver Mus. Nat. Hist.) **11**, 116 pp. (Price, \$1.50).—This publication includes the narrative of the author's visit to New Zealand and a brief systematic account of the remarkable avifauna of New Zealand. The 82 excellent photographs, most of them by the author and Kenneth V. Bigwood, are the major contribution of this publication, which will also serve as a good introduction to the birds of the area.—R. W. S.
- BAILEY, A. M. 1956. Birds of Midway and Laysan Islands. Mus. Pictorial (Denver Mus. Nat. Hist.) **12**, 130 pp. (Price, \$2.00).—An important review of our knowledge of the birds of these islands, beautifully illustrated by photographs and a colored plate of the extinct Laysan Honey-eater (*Himatione sanguinea fraithii*). A bibliography, a list of plants, and a history of the islands add to its usefulness.—R. W. S.

- BARD, F. G. 1956. Whooping Cranes in southern Saskatchewan in 1956. *Blue Jay*, 14: 81.—Four Whooping Cranes were photographed, 2 in June, 2 in July.—R. W. N.
- BARD, F. G. 1956. Whooping Cranes in migration, 1956. *Blue Jay*, 14: 39–42.—A report of observations of two families of Whooping Cranes in late April in Saskatchewan, documented by photographs. Includes a description of the break-up of the family. Previous positive records in Saskatchewan are shown on a map.—R. W. N.
- BELL, L. C. 1955. Notes on the birds of the Chatham Islands. *Notornis*, 6: 65–68.—47 native and introduced species. Population numbers of albatrosses.—W. R. B. O.
- BORRERO, J. I., and A. OLIVARES. 1955. Avifauna de la region de Soatá, Departamento de Boyacá, Colombia. *Caldasia*, 7 (31): 51–81.—A collection of 118 species from the slope of the Eastern Andes. *Dendroica magnolia* and *Seiurus noveboracensis linnaeus* (identified by J. T. Zimmer) recorded for first time in Colombia.—E. E.
- CARRIKER, M. A., JR. 1954. Additions to the avifauna of Colombia. *Noved. Colombianas*, no. 1: 14–19. Univ. del Cauca, Popayan.—A list of species and subspecies new to Colombia collected by the author, giving details as to locality and present location of the specimens. Some of these specimens have been previously reported. *Passerina cyanea* (the first South American specimens), *Cypseloides fumigatus* [Might this be the recently described *C. cryptus* Zimmer? E. E.] and *Alopochelidon fucata* (a swallow of southern South America, probably a migrant) and the furnariid *Phacellodomus rufifrons* new to Colombia.—E. E.
- CHISLETT, R. 1955. Stilt Sandpiper in Yorkshire: A new British Bird. *British Birds*, 48: 18–20.—A Yorkshire record of *Micropalama himantopus* on 31 August 1954.—M. T. M.
- DUGAND, A. 1955. Nuevas observaciones de *Bubulcus ibis ibis* en Colombia. *Caldasia*, 7 (31): 83–86.—Notes on distribution and behavior of the Cattle Egret in Colombia.
- GULLION, G. W., and L. W. HOSKINS. 1956. Noteworthy bird records from northeastern Nevada. *Condor*, 58: 295.—Recent records include those for *Poliophtila caerulea* and *Lanius excubitor*.
- HAMILTON, F. D., and K. S. MACGREGOR. 1955. Wilson's Phalarope in Fife: A new British Bird. *British Birds*, 48: 15–17.—A Scottish record of *Steganopus tricolor*. Three earlier records are mentioned, from 11 September to 5 October 1954.—M. T. M.
- HOUSTON S., and M. HOUSTON. 1955. Following Congdon—53 years later. *Blue Jay*, 13: 18–19.—A list of species seen in 1955 is compared with a list compiled for the same area in northern Saskatchewan in 1902.—R. W. N.
- MARCHANT, S. 1956. Occurrence of the Piping Plover, *Charadrius melodus*, in Ecuador. *Ibis*, 98: 533–534.—♀ imm., Salinas, Guayas Province, October 15, 1955.
- MURIE, A. 1956. Nesting records of the Arctic Willow Warbler in Mount McKinley National Park, Alaska. *Condor*, 58: 292–293.—Although previously known as a common summer resident in the park, the first nest of *Acanthopneuste borealis kennicotti* in North America is described.—D. W. J.
- MURPHY, R. C., A. M. BAILEY, and R. J. NIEDRACH. 1954. Canton Island. *Mus. Pictorial* (Denver Mus. Nat. Hist.) 10, 80 pp. (Price, \$1.00).—A brief history of the island and bibliography (compiled by E. H. Bryan, Jr.) round out

- the account of the 28 species of water birds which have been recorded from this atoll. Illustrated by many excellent photographs, mostly by Alfred M. Bailey and Patricia Bailey Witherspoon.—R. W. S.
- NICÉFORO MARIA, H. 1955. Una cracida nueva para la avifauna colombiana. *Caldasia*, 7 (32): 177-184.—The Helmeted Curassow, *Pauxi pauxi pauxi*, in Colombia.—E. E.
- NICÉFORO MARIA, H. 1955. Notas sobre aves de Colombia, IV. *Caldasia*, 7 (32): 173-175.—In Colombia, first *Bubulcus ibis* was taken March 20, 1949. The *tanager*, *Anisognathus lachrymosus tamae*, new to Colombia.—E. E.
- ORIAN, G. 1954. The Red-tailed Hawk in Wisconsin. *Passenger Pigeon*, 17: 3-10.—Range and population data based on questionnaires and other sources.—R. W. N.
- PHILIPPI B., R. A. 1951. Observaciones sobre aves Norteamericanas migratorias que visitan Chile. *Bol. Mus. Nac. Hist. Nat. (Santiago, Chile)* 25: 79-84.—New or rare North American migrants to Chile.—M. A. T.
- PHILIPPI B., R. A., A. W. JOHNSON, J. D. GOODALL, y F. BEHN. 1954. Notas sobre aves de Magallanes y Tierra del Fuego. *Bol. Mus. Nac. Hist. Nat. (Santiago, Chile)* 24, no. 3, 53 pp., 8 figs.—An annotated list of the birds of Magallanes and Tierra del Fuego with observations and life history notes.—M. A. T.
- RIPLEY, S. D., and D. S. RABOR. 1956. Birds from Canlaon Volcano in the highlands of Negros Island in the Philippines. *Condor*, 58: 283-291.—Following geographic and geologic descriptions of the island, three vegetation (altitudinal) zones are listed, and for each zone the typical bird species occurring therein are mentioned. Sections deal with breeding activity from April 11 through May 21, mixed avian flocks, and call notes. Systematic notes include the description of a new subspecies, *Zosterops montana finitima*.—D. W. J.
- SCHORGER, A. W. 1954. The White Pelican in early Wisconsin. *Passenger Pigeon*, 16: 136-140.—Compilation of historical records; includes data on migration.—R. W. N.
- STEPHENS, T. C., W. G. YOUNGORTH, and W. R. FELTON, JR. 1955. The birds of Union County, South Dakota. *Occasional papers*, no. 1, Nebraska Ornithologists' Union, Crete, Nebraska. 35 pp. (Price \$0.75.)
- STEPHENS, T. C. 1956. An annotated Bibliography of North Dakota Ornithology. *Occasional papers*, no. 2, Nebraska Ornithologists' Union, Crete, Nebraska. 22 pp. (Price \$1.00.)
- STIDOLPH, R. H. D. 1952. White-faced Herons in New Zealand. *Notornis*, 5: 18-19.—*Notophox novaezelandiae* has shown a remarkable increase in numbers during the last ten years. First published account of its breeding in New Zealand, Shag Valley, 1941, by B. A. Ellis.—W. R. B. O.
- STIDOLPH, R. H. D. 1953. New wader for New Zealand—Least Sandpiper. *Notornis*, 5: 115.—*Erolia minutilla*, Wairoa River mouth, Hawke's Bay, Nov. 21, 1952. Subspecies *subminuta* more likely than *E. m. minutilla* to reach New Zealand.—W. R. B. O.
- STIDOLPH, R. H. D. 1954. Status of Godwit in New Zealand. *Notornis*, 6: 31-39.—The author suggests that the summer population of *Limosa lapponica baueri* in New Zealand does not exceed 200,000. The migratory route between Siberia and New Zealand is considered to be in a much more direct line than has been accepted and is not by way of the Malay Peninsula.—W. R. B. O.
- SUTTON, G. M., and D. F. PARMELEE. 1955. On certain Anatids of Frobisher Bay, Baffin Island. *Arctic*, 8: 139-147.—Notes on *Branta canadensis*, *Chen*

- hyperborea*, *Chen caerulescens*, *Clangula hyemalis*, *Somateria mollissima*, *S. spectabilis*, and *Mergus serrator*.—F. M.
- TORDOFF, H. B. 1956. Check-list of the Birds of Kansas. Univ. Kansas Publ., Mus. Nat. Hist., 8: 307-359.—An annotated list of 390 species (15 of which are on a hypothetical list) bringing up to date the records for the distribution of birds in Kansas. The birds are listed by species, with comments on the subspecies found in the state at the end of the species accounts; birds on the hypothetical list are placed in brackets in their place in the regular list. These two departures from the more conventional lists are improvements which could be copied to advantage by other authors.—R. W. S.
- TURBOTT, E. G. 1956. Bulbuls in Auckland. Notornis, 6: 185-193.—The history of establishment of *Pycnonotus cafer* in the vicinity of Auckland. It is possible that the birds were brought from some eastern port, apparently in 1952.—W. R. B. O.
- WESTERSKOV, K. 1954. Spread of the Australian Magpie within the Rotorua Acclimatization district. Notornis, 5: 243-248.—*Gymnorhina hypoleuca* and *G. tibicen* seem to thrive in sheep country, where most of their requirements are satisfied.—W. R. B. O.

ECOLOGY AND POPULATION

- GIBB, J. 1954. Population changes of Titmice, 1947-1951. Bird Study, 1: 40-48.—In Marley Wood, Wytham, near Oxford.
- HOFFMANN, R. S. 1956. Observations on a Sooty Grouse population at Sage Hen Creek, California. Condor, 58: 321-337.—By observation of a semi-isolated Sooty Grouse population, information is brought to bear on recent taxonomic and cyclic problems in grouse. Differences in courtship behavior, displays, and territoriality are indicated for the Dusky Grouse (*obscurus* group) and Sooty Grouse (*fuliginosus* group). Historical evidence for cycles in Blue Grouse (*obscurus* group) is reviewed, and the evidence accruing therefrom is regarded as incomplete. Data are presented to show that both Sooty Grouse and Snowshoe Hare populations declined sharply from 1952 to 1953. Perhaps this decline is of the same nature as has been found in the proposed cycles in the *obscurus* group.—D. W. J.
- HORVÁTH, L. 1956. Communities of breeding birds in Hungary. Acta Zool. Acad. Scient. Hungaricae, 2, fasc. 4: 319-331, 1 fig. (In English, summary in Russian.)—The 192 species known to breed in Hungary are classified in 38 groups, containing from 3 to 19 species with an average of 5 in each, that nest in the same general type of habitat.
- JOHNSTON, R. F. 1956. Population structure in salt marsh Song Sparrows. Parts I and II. Condor, 58: 24-44; 254-272.—This significant investigation involves a study of a color-banded population of *Melospiza melodia samuelis* over a period of five years. The factors which influence the initiation of breeding are photoperiod, temperature, and rainfall. The salt marsh forms breed earlier than upland forms at the same latitude as an adaptation to escape high tides. Clutch-size is determined by the quantity and quality of food, population density, and mortality rates. Other data are presented on territoriality and dispersal of juveniles and adults.

In some years the density was 10 pairs per acre, this density varying directly with the preceding year's productivity. Natality and mortality rates and a life table are given. This distinct population of Song Sparrows is maintained by habitat selection, a high density, and strong isolation.—D. W. J.

- KOEPKE, M. 1954. Corte ecológico transversal en los Andes del Perú central con especial consideración de las aves. Parte I: Costa, vertientes occidentales y región altoandina. Mem. Mus. Hist. Nat. Javier Prado, No. 3: 1-119. Univ. Nac. Mayor de San Marcos, Lima.—An ecologic study, with special reference to birds, of a transect of central Peru from the coast to the Andean summits. Describes the various habitats with lists of the birds found in each, and discusses adaptations to varying conditions. Photographs, drawings and diagrams. Should be useful to students of neotropical bird distribution and visitors to Peru. (In Spanish, with German summary.)—E. E.
- ORIAN, G., and F. KUHLMAN. 1956. Red-tailed Hawk and Horned Owl populations in Wisconsin. Condor, 58: 371-385.—On a 95-square-mile farm tract, the authors studied interactions between *Buteo jamaicensis* and *Bubo virginianus* for three years. For both species there is a discussion of winter and breeding populations, nests, and food. These two predators competed for food (pheasants and cottontail rabbits) and nest sites. Emphasis is given to the study of taxonomically unrelated species in order to elucidate interactions of animal populations.—D. W. J.
- PLATT, D. 1956. Food of the Crow, *Corvus brachyrhynchos* Brehm, in South-central Kansas. Univ. Kansas Publ., Mus. Nat. Hist., 8: 477-498.—Analysis of 617 regurgitated pellets collected throughout the year showed 69 per cent plant material, mostly wheat and other grains. The author believes that the Crow, being euryphagous, exerts a stabilizing influence on many kinds of prey and on the biotic community as a whole.—R. W. S.
- SCHORGER, A. W. 1954. A study of road kills. Passenger Pigeon, 16: 53-55.—Records of birds killed on a 70-mile stretch of road over 18 consecutive years.—R. W. N.

EVOLUTION AND GENETICS

- IRWIN, M. R. 1955. On interrelationships of the cellular antigens of several species of *Streptopelia*. Evolution, 9: 261-279.—On the basis of antigenic substances the eight species are assigned to three fairly well-defined groups.—J. C. H.
- JONES, D. G., and W. MORGAN. 1956. Woolly feathering in the fowl. Journ. Heredity, 47 (3): 137-141.
- LANDAUER, W. 1956. A second diploped mutation of the fowl. Journ. Heredity, 47 (2): 57-63.—The new mutant occurred in Black Minorca fowl and was very similar to a diploped mutation earlier reported in White Leghorn fowl. These two mutants are non-allelic.—J. C. H.
- LORENZ, F. W., V. S. ASMUNDSON, and N. E. WILSON. 1956. Turkey hybrids. Journ. Heredity, 47 (3): 142-146.—Fertilizing female domesticated turkeys (*Meleagris gallopavo*) with sperm obtained from a male Ocellated Turkey (*Agriocharis ocellata*) resulted in fair to good fertility, with a hatch of fertile eggs comparable to that of eggs from domestic turkeys, good post-hatching viability at least in males, and the production of fertile hybrids. The F_1 progeny are intermediate in all traits observed except the voice, which is similar to that of *ocellata*.—J. C. H.
- MAKINO, S., T. UDAGAWA, and Y. YAMASHINA. 1956. Karyotype studies in birds. 2: a comparative study of chromosomes in the *Columbidae*. Caryologia, 8: 275-293.—Studies on the chromosomes of *Columba livia*, *C. janthina*, *Streptopelia decaocto*, *S. orientalis*, *S. decaocto* \times *orientalis*, and *Sphenurus sieboldii*.—R. W. S.
- MILLER, A. H. 1955. A hybrid woodpecker and its significance in speciation

- in the genus *Dendrocopos*. *Evolution*, 9: 317-321.—A female specimen intermediate in a number of characters between *D. villosus* and *D. scalaris* was taken in Coahuila, Mexico, in April. It is thought to have been an F_1 hybrid. In general the cross-barred feather patterns of the back and tail of *scalaris* dominate. On the other hand, restriction or elimination of the white on the lateral aspects of the back and especially on the wing coverts shows dominance, partial to complete, of the *villosus* characters. This hybrid bears a strong resemblance to *D. borealis* of the south-eastern United States. It is suggested that *borealis* may have an evolutionary history of hybridization and introgression.—J. C. H. MILLER, W. J. 1956. Silky plumage in the Ring Neck Dove. *Journ Heredity*, 47 (1): 37-40.
- SIBLEY, C. G. 1956. A white-throated Golden-crowned Sparrow. *Condor*, 58: 294-295.—A specimen of *Zonotrichia atricapilla* with a white throat is described, and the possible origin of this condition is discussed.—D. W. J.
- UDAGAWA, T. 1955. Karyogram studies in birds. VI. The chromosomes of five species of the Turdidae. *Annot. Zool. Jap.*, 28: 256-261.—*Turdus pallidus*, *T. c. celanops*, *Monticola solitarius magnus*, *Phoenicurus a. aureus*, and *Erithacus c. cyane*.—R. W. S.
- WALLACE, G. J. 1956. A case of microphthalmia in the American Robin. *Wilson Bull.*, 68: 151-152.—In a fledgling *Turdus migratorius*.
- YAMASHINA, Y. 1953. Phenotypical differentiation of endemic birds in relation to island size in Micronesia. *Proc. VII Pac. Sci. Congr.*, 4: 61-66.—Geological period of emergence of the islands. The major determinants of differentiation are the number of generations, size of population, and degree of selection.—W. R. B. O.

GENERAL BIOLOGY

- BAILEY, A. M. 1952. Laysan and Black-footed Albatrosses. *Mus. Pictorial* (Denver Mus. Nat. Hist.) 6, 80 pp. (Price, \$1.00).—A valuable account of the habits of *Diomedea immutabilis* and *D. nigripes*, based on original observations as well as those reported in the literature. The 42 photographs of these birds are outstanding and include series of illustrations of the "dance" of both species.—R. W. S.
- BETTS, M. M. 1955. The behaviour of a pair of Great Tits at the nest. *British Birds*, 48: 77-82.—The rate of feeding of a brood of Great Tits by the parents reached a peak on the eleventh day, but the size of each food item continued to increase. In 22 per cent of all visits two or more items were brought together. The use of recorders of visiting frequencies thus fails to give a completely accurate picture of feeding activity. The male's share in feeding decreased steadily during the nestling period. Day brooding by the female ceased after the seventh morning. There are notes on nest sanitation, and on awakening and roosting.—M. T. M.
- BLAKE, E. R. 1956. A collection of Panamanian nests and eggs. *Condor*, 58: 386-388.—Descriptions are given for sixteen species of noteworthy interest.—D. W. J.
- BRADSHAW, F. 1956. The home of the Whooping Crane. *Blue Jay*, 14: 76-78.—A personal account of the discovery of a Whooping Crane nest in Saskatchewan on May 29, 1922.—R. W. N.
- GIBB, J. 1955. Feeding Rates of Great Tits. *British Birds*, 48: 49-58.—Part of a major study of *Parus major*. A mechanical recorder, of the time of parental visits to the nest, is explained and illustrated. Of weather conditions only heavy

rain reduced feeding rate. Nestlings in smaller broods receive more food than those in larger broods. Late broods have fewer young than first broods. Young in late broods had a lower individual average weight than young in large first broods. Many of the young in late broods died at about 15 days of age. In large first broods and in late broods, the total number of visits decreased in the afternoon and in the later stages of the nestling period. It is concluded the parents were more strained in these cases than they were if they had small first broods.—M. T. M.

HAVERSCHMIDT, F. 1956. Notes on a nest of the Guianan Chachalaca. *Condor*, **58**: 293-294.—*Ortalis motmot* in Surinam.

LANYON, W. E. 1953. Meadowlarks in Wisconsin. *Passenger Pigeon*, **15**: 99-112, 150-158.—Part 1. Historical and ecological aspects of Meadowlark distribution based on questionnaires and field notes from many persons and on personal research. Part 2. Wintering, migration, song, and breeding biology in Wisconsin.—R. W. N.

SILBY, G., and J. A. SELBY. 1955. Ruby-throated Hummingbirds at Lookout Point. *Bull. Federation of Ontario Naturalists*, **70**: 9-20.—Observations on behavior and breeding biology. Three types of display flights are distinguished.—F. M.

SUTTON, G. M., and D. F. PARMELEE. 1956. Breeding of the Snowy Owl in southeastern Baffin Island. *Condor*, **58**: 273-282.—Ten nestings of *Nyctea scandiaca* in 1953 showed clutch-size to vary between 2 and 10, and that 62 chicks were hatched from 69 eggs. Territories covered about a mile in diameter, these being defended, at times, by both sexes. In a nest containing nine eggs, hatching was spread over a period of about 15 days. The natal plumage is described. Lemmings were the exclusive food.—D. W. J.

MANAGEMENT AND CONSERVATION

ANDERSON, W. 1956. A waterfowl nesting study on the Grasslands, Merced County, California. *Calif. Fish and Game*, **42**: 117-130.—Excessive predation by mammals (mostly skunk and opossum) accounted for the loss of 61.7 per cent of duck nests in 1953 and 82 per cent in 1954. Photography was used to confirm the identity of predators; a wire connected the camera shutter with the eggs so that the predator photographed itself.—F. M.

ANON. 1954. The New Protection of Birds Act. *British Birds* (Editorial), **47**: 409-413.—The old law relating to bird protection in Great Britain was highly confused and conditions varied from county to county. The long-needed revision was finally passed in 1954 (Protection of Birds Act, 1954) and involved the total repealing of 15 earlier Acts. All birds and their nests are now protected throughout England, Wales and Scotland unless they appear in the brief lists of species variously excepted.—M. T. M.

CARRICK, R. 1956. The Little Corella, *Kakaloe sanguinea* G., and rice cultivation in the Kimberley region, W. A. *C.S.I.R.O. Wildlife Research*, **1**: 69-71.

GENELLY, R. E., and R. L. RUDD. 1956. Chronic toxicity of DDT, Toxaphene, and Dieldrin to Ring-necked Pheasants. *Calif. Fish and Game*, **42**: 5-14.

HUNT, E. G., and A. E. NAYLOR. 1955. Nesting studies of ducks and coots in Honey Lake Valley. *Calif. Fish and Game*, **41**: 295-314.—Studies in Lassen County, in 1951 and 1953, provide detailed data on nest sites and preferred cover types, nesting periods, and the fate of nests and broods for eight duck species and the coot. The nesting success was about 50 per cent for ducks and 96 per

- cent for coots. Predation was the most important cause of unsuccessful nesting.—F. M.
- LASSEN, R. W., K. E. DOTY, and R. D. SAUCERMAN. 1955. Sexing day-old Ring-necked Pheasant chicks by a color characteristic. *Calif. Fish and Game*, **41**: 229-231.
- MACGREGOR, W. G., and W. M. SMITH. 1955. Nesting and reproduction of the Band-tailed Pigeon in California. *Calif. Fish and Game*, **41**: 315-326.—A study in Monterey County gives data on 26 nests. "In all but one nest, clutch size was one egg. Nesting occurred as early as February and as late as October. Observations on a single pair of birds revealed three broods successfully fledged during the 1954 nesting season." Hunting seasons have been adjusted to protect the late-nesting birds.—F. M.
- NORRIS, R. A. 1956. Introduction of exotic game birds in Georgia. *Oriole*, **21**: 1-6.
- SCOTT, W. E. 1955. The management of predacious and fish-eating birds in Wisconsin. *Passenger Pigeon*, **17**: 51-58.—Statement of the present management problem as viewed by members of Wisconsin Conservation Department.—R. W. N.
- WESTERSKOV, K. 1953. Pheasant banding in New Zealand, 1948-51. *Notornis*, **5**: 157-164.—The recovery of only 3.4 per cent of pen-reared birds indicates a very low survival rate.—W. R. B. O.

MIGRATION AND ORIENTATION

- ALEXANDER, W. B., and R. S. R. FITTER. 1955. American Land Birds in Western Europe. *British Birds*, **48**: 1-14.—An important review of 38 species of North American land birds which may be considered acceptable as naturally occurring vagrants in Europe. Williamson (1954) stated that "speed is the *sine qua non* of a successful transatlantic crossing, and it is very doubtful if any small or medium-sized Passerine or wader could make it other than by a continuous downwind drift in the strong westerly airstream of a vast Atlantic low." Birds traveling on a ship (a common explanation in the past of such vagrant records) would lose weight too rapidly to survive. Again, 103 land bird records and 203 wading bird records are grouped according to month of occurrence, and the majority occurred in the spring or fall; "what cannot be accepted is that birds tend to escape (from captivity) more at the normal migration periods than at other times of year." A systematic list of species with claims to European status is included.—M. T. M.
- BAGG, A. M. 1955. Airborne from Gulf to Gulf. *Bull. Mass. Aud. Soc.*, **39**: 106-110, 159-168.—Simultaneous observations in eastern North America show how a strong flow of tropical air from the Gulf of Mexico carried migrant Indigo Buntings from Central America to the Gulf coast of Florida and coastal areas from Long Island to Nova Scotia during the period April 16 to 18, 1954.—F. M.
- CARRICK, R. 1956. The Australian bird-banding scheme. *C.S.I.R.O. Wildlife Research*, **1**: 26-30.—A national scheme was launched in 1953 by the Wildlife Survey Section, C.S.I.R.O., with headquarters at Canberra.
- CARRICK, R., and N. TURNBULL. First annual report of the Australian bird-banding scheme, October 1953 to June 1955. *C.S.I.R.O. Wildlife Research*, **1**: 31-39.
- CORNWALLIS, R. K. 1954. The Pattern of Migration in 1953 at the East Coast Bird Observatories. *British Birds*, **47**: 423-431.—A chronological description of the spring and fall migration of 1953 on the east coast of England and Scotland.

- There were few drift migrants in the spring. No hold-up of migration occurred in the fall, to be released later as coincident peaks at the various observatories. Drift migrants did however usually coincide at several stations.—M. T. M.
- DAVIS, P. 1954. The Pattern of Migration in 1953 at the Irish Sea Bird Observatories. *British Birds*, 47: 414-422.—Analyses of the spring and fall migration of 1953 at four island observatories in St. George's Channel and the Bristol Channel. Twelve species normally migrating through this region showed numerous peaks of migration with a high proportion of peaks "shared between two or more observation stations." The differences between the factors producing normal migration and drift movements are "emphasised by the large measure of dissociation between the dates of the vagrant records and those of the main movements of the regular migrants." Conditions favoring each type are discussed.—M. T. M.
- DUNNET, G. M. 1956. Common Tern, *Sterna hirundo hirundo* L., banded in Sweden and recovered in Australia. C.S.I.R.O. Wildlife Research, 1: 68.—The first record of *S. h. hirundo* for the Australian continent.
- JOHNSTON, D. W. 1956. Average date of arrival of spring migrants at Macon, Georgia. *Oriole*, 21: 27-29.
- KALMUS, H. 1956. Sun navigation of *Apis mellifica* L. in the southern hemisphere. *Journ. Exp. Biol.*, 33: 554-565.—Honey bees from a local Brazilian stock compensated for counter-clockwise azimuth changes in sun position in orienting to foraging grounds. Inseminated queen bees of the same species imported from the northern hemisphere produced workers which systematically compensated for clockwise azimuth changes and thus oriented falsely. Hybrids also showed false orientation. The mechanism which compensates for changing sun position in orientation thus appears to be innate, and the adaptation to the southern hemisphere situation in Brazilian bees must have occurred since their importation from Europe in the 16 century.—J. T. R.
- KRAMER, G., J. G. PRATT, and U. VON ST. PAUL. 1956. Directional differences in pigeon homing. *Science*, 123 (3191): 329-330.—Pigeons released to the south of two home lofts showed a marked superiority in their ability to return to the loft when compared with pigeons released to the east, west, or north. Performances were tested for two distances: 16 to 17¼ miles and 53 to 60 mi. The same pigeons were used for a number of independent flights. Individual pigeons were released in different directions on different independent flights. This study was carried out in the Durham, N. C. region.—J. C. H.
- MARSHALL, A. J., and D. L. SERVenty. 1956. Moults adaptation in relation to long-distance migration in petrels. *Nature*, 177 (4516): 943.—*Puffinus tenuirostris* molts in the head and body at its Tasmanian breeding grounds but not the wing and tail feathers until the bird reaches N. Pacific and Arctic waters. This post-migratory wing molt seems characteristic of trans-equatorial migrant petrels.—H. C. S.
- MATTHEWS, G. V. T. 1952. The relation of learning and memory to the orientation and homing of pigeons. *Behaviour*, 4: 202-221.—Choice experiments showed that learning ability has no positive relation to orientation or homing ability. Pigeons could learn to go to food below, opposite or at right angles to an "artificial sun." "The learning is slow, and not very accurate, suggesting that it is not part of the birds' normal behaviour."—P. M.
- MATTHEWS, G. V. T. 1955. An investigation of the 'chronometer' factor in bird navigation. *Journ. Exp. Biol.*, 32: 39-58.—Shearwaters and Pigeons subjected

to artificial days of normal length but advanced or retarded by three hours tended to fly in the directions predicted on the basis of an altered internal chronometer rather than in the correct homeward direction. These results are interpreted as supporting a theory of bicoordinate sun navigation to explain homing in birds.—J. T. E.

- MITCHELL, K. D. G. 1955. Aircraft Observations of birds in flight. *British Birds*, 48: 59–70.—Commercial flights over the United Kingdom and Western Europe, chiefly in the summer months. 89 per cent of all flying time was above 2000 ft., but only 32 per cent of all birds observed were seen above 2000 ft. Birds are encountered once every 70 hours of flying by day. Non-local birds (i.e. omitting feeding and roosting flights) showed peaks in March and October.—M. T. M.
- PRATT, J. G. 1955. An investigation of homing ability in pigeons without previous homing experience. *Journ. Exp. Biol.*, 32: 70–83.—Pigeons with no previous experience oriented towards the home loft from distant release points as well and reached the loft as frequently as pigeons with experience in the loft vicinity. A difference in homing performance was found between two stocks. Birds released from the top of a 100 ft. tower vanished towards the home loft more quickly than pigeons released at ground level.—J. T. E.
- PRATT, J. G., and R. H. THOULESS. 1955. Homing orientation in pigeons in relation to opportunity to observe the sun before release. *Journ. Exp. Biol.*, 32: 140–157.—To test the Matthews hypothesis that correct orientation in unfamiliar territory depends on an interval of time for observing the sun's motion along its arc, experimental pigeons were allowed to see the sun for varying lengths of time before release while others were screened until release. Both groups oriented towards the home loft with equal accuracy.—J. T. E.
- SERVENTY, D. L. 1956. First recoveries in the northern hemisphere of Tasmanian Mutton Bird, *Puffinus tenuirostris* (Temminck), banded in Australia. *C.S.I.R.O. Wildlife Research*, 1: 72.
- SHAUB, B. M., and M. S. SHAUB. 1956. The Evening Grosbeak survey 1947–1956. *Passenger Pigeon*, 18: 3–15.—Study of movement of Grosbeaks in eastern United States and Canada.—R. W. N.
- SPIERS, J. M. 1956. The migratory phase of Robin behaviour. *Bull Federation of Ontario Naturalists*, 72: 20–27.—“Except for the nesting season and the period of moult robins are truly wandering thrushes and well deserve their name.” Data from the winter of 1939–40 are presented to show the winter movements of *Turdus migratorius* in eastern North America in response to weather conditions and food supply.—F. M.
- TORDOFF, H. B., and R. M. MENGEL. 1956. Studies of birds killed in nocturnal migration. *Univ. Kansas Publ., Mus. Nat. Hist.*, 10: 1–44.—An analysis of 1090 birds of 61 species killed near Topeka, Kansas, between September 25 and October 23, 1954. Weight, sex, age, and fat condition of all individuals were recorded, and certain species were also measured. Differential migration of sex- and age-groups is discussed and the history of theories on this subject reviewed. Other uses of material obtained from large migration accidents are discussed and the authors point out the value of data obtained from material of this sort in solving many problems which have been little studied. This paper should be studied by anyone planning to make use of birds killed in similar accidents.—R. W. S.
- WILLIAMSON, K. 1954. The Migration of the Iceland Merlin. *British Birds*,

47: 434-441.—Merlin appearing at Fair Isle in the fall are of the Icelandic race, *Falco columbarius subaesonum*. "The data support the view that clear skies and a lack of wind provide the stimulus to undertake a migratory flight, and show that journeys are made in any type of pressure-system which offers these conditions." The fall movement implies a S. E.-orientated flight.—M. T. M.

PHYSIOLOGY

- GORDON, R. S., and I. W. SIZER. 1955. Ability of sodium sulfate to stimulate growth of the chicken. *Science*, **122** (3183): 1270-1271.
- HUTCHINSON, J. C. D. 1956. Control of seasonal variation in the egg production of hens. *Nature*, **177** (4513): 795-796.—Reduction of light from 23½ hours to 12 hours per day induced molt and inhibited egg production even though the controls kept on a 12 hour day showed no such symptoms.—H. C. S.
- IRVING, L., and J. KROG. 1956. Temperature during the development of birds in arctic nests. *Physiol. Zool.*, **29**: 195-205.—Observations on seven species of nesting birds were made at Anaktuvuk Pass, Alaska, where the air temperature was generally cool and often around freezing. About the same temperature was found during incubation as has been found in nests near Cleveland, and efficient parental care appears to maintain uniform conditions for incubation and brooding which are independent of climatic variations. The nestling stage of Fringillidae in the arctic seems to be about 1 day (out of 10) shorter than in temperate regions.—F. M.
- JOHNSON, V. L., and J. S. DUNLOP. 1955. Electrophoretic separation of hemoglobins from the chicken. *Science*, **122** (3181): 1186.
- LEVINE, J. 1955. Consensual pupillary response in birds. *Science*, **122** (3172): 690.—Unlike mammals, stimulating one eye of a bird by means of a beam of light will not produce a pupillary contraction in the eye which is not stimulated equaling that of the stimulated eye.—J. C. H.
- MARSHALL, A. J., and S. J. FOLLEY. 1956. The origin of nest-cement in edible-nest swiftlets (*Collocalia* spp.) *Proc. Zool. Soc. Lond.*, **126**: 383-389.—Examination of new material of the alimentary tract of two species of *Collocalia* seems to confirm the theory that nest-cement is produced by salivary glands. It is suggested that the seasonal development of these glands is under hormonal control.—F. M.
- RYLE, M., and M. SIMONSEN. 1956. Attempts at hybridization of chickens and turkeys which are tolerant of each others' antigens. *Nature*, **177** (4505): 437-38.
- SHIRLEY, H. V., JR., and A. V. NALBANDOV. 1956. Effects of transecting hypophyseal stalks in laying hens. *Endocrin.*, **58**: 694-700.
- WILLIAMSON, F. S. L. 1956. The molt and testis cycles of the Anna Hummingbird. *Condor*, **58**: 342-366.—For *Calypte anna* pterylography and timing of molt are presented in detail for both sexes. Males molt between June and January, and come into breeding condition rather abruptly in December before the winter solstice. The inception of the breeding condition is most closely correlated with the number of consecutive days of rainfall, but it may be modified by other factors, such as the arrival of females. Territoriality and displays are most prevalent beginning in December. Although no concerted attention was given to androgenic studies, statements are made to the effect that "functional interstitial cells are abundant" while the testes are small and not in breeding condition. Should this be true for this species, this fact is inconsistent with the findings of cyclic hormonal investigations on passerine and nonpasserine birds.—D. W. J.

TAXONOMY AND PALAEONTOLOGY

- BOCK, W. J. 1956. A generic review of the Family Ardeidae (Aves). Amer. Mus. Novitates No. 1779, 49 pp.—The herons are divided into two subfamilies, the Botaurinae and the Ardeinae, and the latter is divided into three tribes, the Tigrionithini, the Nycticoracini (including *Cochlearius*), and the Ardeini. Bock recognizes 64 species and 15 genera, as compared to 70 species and 32 genera in Peters' classification. The author states "I am continuing study of the relationships of the Ardeidae and have started an investigation of the comparative and functional anatomy of herons."—R. W. S.
- BRODKORB, P. 1956. Two new birds from the Miocene of Florida. Condor, 58: 367-370.—*Phalacrocorax subvolans* and *Proictinia floridana* are described.
- HORVÁTH, L., and A. KEVE. 1956. The subspecies of the Dunlin in Hungary. Ann. Hist.—Nat. Mus. Nat. Hungarici, 7, new series: 469-476. (In English, summary in Russian.)—*Calidris alpina alpina* (Linnaeus) (= *Erolia* of the A.O.U. check-list) is the most common, with *schinzi* (Brehm) next. Six specimens are referred to *centralis* Buturlin, which is separated from the nominate form on the basis of longer wing (118-122 mm.). Migration is from March to June, and July to December, with the main flights in April-May and September.
- KURODA, N. 1955. Osteological notes on the Buller's Shearwater, *Puffinus bulleri* Salvin. Annot. Zool. Jap., 28: 167-170.—The author's classification of the subgenus *Thyellodroma* as a "partial aquatic" group is confirmed by this study of *bulleri*.—R. W. S.
- KURODA, N. 1955. On the osteology of the Gadfly-Petrels, *Pterodroma*. Annot. Zool. Jap., 28: 171-177.—Based on study of skeletons of *Pterodroma inexpectata* and *P. solandri*. Kuroda concludes that this group of petrels is more closely related to the fulmars and storm petrels than to the shearwaters.—R. W. S.
- PARTRIDGE, W. H. 1954. Estudio preliminar sobre una colección de las aves de Misiones. Rev. Inst. Nac. Cienc. Nat. Zool., 3 (2): 87-153. Buenos Aires.—Study of a collection from the Territory of Misiones, northeastern Argentina, including five forms new to that country (*Leptasthenura setaria*, *Pseudattila phoenicurus*, *Psilorhamphus guttatus*, *Pitangus sulphuratus maximiliani*, and *Cnemotriccus fuscatus fuscatus*), as well as many new to Misiones, and others little known. Taxonomic discussion as to various forms. (In Spanish, with brief English summary.)—E. E.
- PLOTNICK, R., and M. J. I. PERGOLANI DE COSTA. 1955. Clave de las familias de Passeriformes representadas en la Argentina. Rev. de Investigaciones Agrícolas, 9 (2): 65-88. Buenos Aires.—Almost the entire collection in the Museo Argentino de Ciencias Naturales of Passeriformes (over 12,500 specimens) was studied to provide a key to the families of that order represented in Argentina. It was found that the external structural characters traditionally used to separate families (tarsal envelope, length of outer primary, bill shape, etc.) were inadequate to afford any satisfactory separation of the following: a) Sylviidae, Troglodytidae, Mimidae, and Turdidae; b) Parulidae, Coerebidae, Thraupidae, and Icteridae; c) Furnariidae and Dendrocolaptidae; d) Formicariidae, Cotingidae, Tyrannidae, Pipridae, and Conopophagidae. Even in a highly artificial key limited to the Argentine species, some Tyrannidae could not be separated from Cotingidae, while others could be distinguished from Pipridae only by considering color. The nature of the tarsal envelope is the chief character traditionally used to separate families in the suborder Tyranni. (The other supposed character of importance, the structure of the syringeal muscles, has been studied in but a

small proportion of the species, for anatomical specimens are required.) Yet the true character of the tarsal envelope is at times hard to determine, for it is subject to deformation in drying, so that what was originally one type of envelope may get to look superficially like a different type. Drawings are included of various kinds of tarsal deformations resulting from desiccation, and a method is suggested for avoiding them.—E. E.

RAND, A. L., and R. L. FLEMING. 1956. Two new birds from Nepal. *Fieldiana. Zool.*, 39: 1-3.—*Dendrocopos auriceps conoveri* and *Garrulax affinis bethelae*, new subspecies.

VERHEYEN, R. 1956. Contribution à l'anatomie et à la systématique des touracos (Musophagi) et des (Cuculiformes). *Bull. Inst. Roy. Sci. Nat. Belg.*, 32, no. 23, 28 pp.—The author believes that the resemblances between the turacos and the cuckoos are the result of convergence and that the former are related to the Galliformes and the latter to the Piciformes and Coliiformes. He divides the cuckoos into two suborders and six families.—R. W. S.

VON SNEIDERN, K. 1954. Notas sobre algunas aves del Museo de Historia Natural de la Universidad del Cauca, Popayan, Colombia. *Noved. Colombianas*, no. 1: 3-13. Univ. del Cauca, Popayan.—Notes on certain birds in the museum mentioned in the title. Many involve range extensions into southwestern Colombia, or are rare or unusual in color.—E. E.

WETMORE, A. 1956. Footprint of a bird from the Miocene of Louisiana. *Condor*, 58: 389-390.

WETMORE, A., and W. H. PHELPS, JR. 1956. Further additions to the list of birds of Venezuela. *Proc. Biol. Soc. Washington*, 69: 1-10.—*Amazilia distans*, *Philydor hylobius*, and *Grallaria chthonia*, new species. *Crypturellus noctivagus cursilans*, *Chaetura vauxi aphanes*, *Acrochordopus zeledoni bunites*, *Hylophilus aurantiifrons helvinus*, and *Hylophilus flavipes galbanus*, new subspecies. *Hemispingus m. melanotis* recorded from Táchira.—R. W. S.

NOTES AND NEWS

The Ecological Society of America has formed a Section of Animal Behavior and Sociobiology. Three major problems in the field of behavior studies—publications, terminology, and teaching—are being investigated. Further information on the Section may be obtained by writing the secretary, Dr. Martin W. Schein, Department of Poultry Husbandry, Pennsylvania State University, University Park, Pennsylvania.

The Frank M. Chapman Fund, established to provide financial assistance to young scientists conducting research in ornithology, makes awards annually in April. Applications should be received before March 31. All correspondence should be directed to the Chairman, Chapman Memorial Fund Committee, Department of Birds, The American Museum of Natural History, Central Park West at 79th Street, New York 24, N. Y.

The first Pan-African Ornithological Congress will be held at Livingstone, Northern Rhodesia (6 miles from Victoria Falls) from July 15 to 20, 1957. Further information may be obtained from the Hon. Secretary of the South African Ornithological Society, P. O. Box 1616, Cape Town.

OBITUARY

GEOFFREY GREAM OMMANNEY, elected a member of the A.O.U. in 1941, died at "Winglands," his home in Hudson Heights, Quebec, on July 18, 1955. He was 76 years of age.

Born in England, a son of Sir Montagu F. Ommanney, at one time Permanent Undersecretary of State for the Colonies, Mr. Ommanney qualified as a civil engineer at King's College, London, and specialized in harbor engineering. After some years of experience in England and the East, he came to Canada and in 1907 joined the engineering staff of the Canadian Pacific Railway. He was in charge of the construction of the Railway's eastern Great Lakes Terminal at Port McNicoll, Ontario. During the First World War he served in France with the British Expeditionary Force and was demobilized with the rank of major. Returning to the C.P.R., he organized and took charge of its development branch and was Development Commissioner when he retired in 1944.

An ardent conservationist, he was for many years a director of the Province of Quebec Society for the Protection of Birds, retiring because of failing health in 1953. He was the most active bird-bander in the Montreal area and maintained a banding station in conjunction with a winter-feeding station at Hudson Heights on the south side of the Lake of Two Mountains. He played an active part in the establishment and maintenance of the Whitlock Bird Sanctuary. He kept careful records of his own observations and of those who assisted him in the study of the birds of that neighborhood. Some of his notes were published in 'The Auk' and others in the annual reports of the P.Q.S.P.B.

A man of strong convictions and a doughty fighter, "Geoff" Ommanney was also a charming companion and a loyal friend. His courage and cheerfulness during the years when his health was failing was an inspiration to all who knew him.—
G. H. MONTGOMERY.

Editor, The Auk

University of Michigan, Museum of Zoology
Ann Arbor, Michigan

Dear Dr. Storer:

The Conservation Department of Cornell University is conducting a research project concerned with hybridization in surface-feeding ducks, including the Mallard, Pintail, Black Duck, Gadwall, Green-winged Teal, Blue-winged Teal, and Shoveller. The purpose of this study is to obtain further information on the relationships within this controversial group, using behavioral data, relative fertility determinations, and, possibly, other physiological techniques. It is hoped that the greatest possible number of hybrid crosses among these species may be studied, and we are in need of first generation male hybrids of known parentage for this purpose. Any aviculturist who happens to possess such birds, and who is willing to lend them to the Department for this project could assist us greatly. It would be appreciated if interested persons would contact Charles G. Sibley or Paul A. Johnsgard, Department of Conservation, Cornell University, Ithaca, New York.

Sincerely yours,

Charles G. Sibley
Associate Professor of Ornithology

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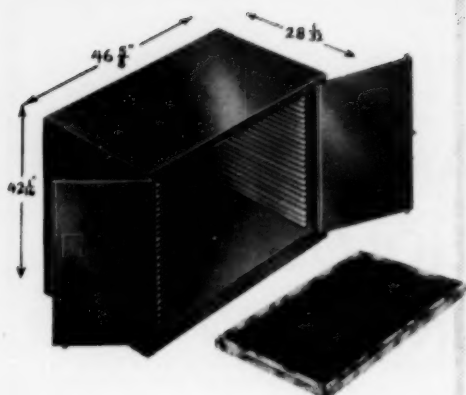
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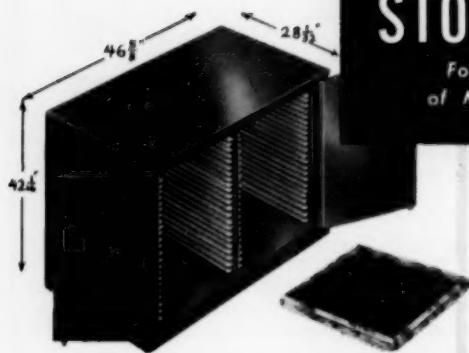
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All articles and notes submitted for publication and all books and publications intended for review should be sent to the Editor.

ROBERT W. STORER, *Museum of Zoology, University of Michigan, Ann Arbor Michigan.*

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